Thoracic imaging tests for the diagnosis of COVID-19

Cochrane COVID-19 Diagnostic Test Accuracy Group

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Thoracic imaging tests for the diagnosis of COVID-19

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ABSTRACT

Background

The diagnosis of infection by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) presents major challenges. Reverse transcriptase polymerase chain reaction (RT-PCR) testing is used to diagnose a current infection, but its utility as a reference standard is constrained by sampling errors, limited sensitivity (71% to 98%), and dependence on the timing of specimen collection. Chest imaging tests are being used in the diagnosis of COVID-19 disease, or when RT-PCR testing is unavailable.

Objectives

To determine the diagnostic accuracy of chest imaging (computed tomography (CT), X-ray and ultrasound) in people with suspected or confirmed COVID-19.

Search methods

We searched the COVID-19 Living Evidence Database from the University of Bern, the Cochrane COVID-19 Study Register, and The Stephen B. Thacker CDC Library. In addition, we checked repositories of COVID-19 publications. We did not apply any language restrictions. We conducted searches for this review iteration up to 5 May 2020.

Selection criteria

We included studies of all designs that produce estimates of test accuracy or provide data from which estimates can be computed. We included two types of cross-sectional designs: a) where all patients suspected of the target condition enter the study through the same route and b) where it is not clear up front who has and who does not have the target condition, or where the patients with the target condition are recruited in a different way or from a different population from the patients without the target condition. When studies used a variety of reference standards, we included all of them.

Data collection and analysis

We screened studies and extracted data independently, in duplicate. We also assessed the risk of bias and applicability concerns independently, in duplicate, using the QUADAS-2 checklist and presented the results of estimated sensitivity and specificity, using paired forest plots, and summarised in tables. We used a hierarchical meta-analysis model where appropriate. We presented uncertainty of the accuracy estimates using 95% confidence intervals (CIs).

Main results

We included 84 studies, falling into two categories: studies with participants with confirmed diagnoses of COVID-19 at the time of recruitment (71 studies with 6331 participants) and studies with participants suspected of COVID-19 (13 studies with 1948 participants, including three case-control studies with 549 cases and controls). Chest CT was evaluated in 78 studies (8105 participants), chest X-ray in nine studies (682 COVID-19 cases), and chest ultrasound in two studies (32 COVID-19 cases). All evaluations of chest X-ray and ultrasound were conducted in studies with confirmed diagnoses only. Twenty-five per cent (21/84) of all studies were available only as preprints, 15/71 studies in the confirmed cases group and 6/13 of the studies in the suspected group.

Among 71 studies that included confirmed cases, 41 studies had included symptomatic cases only, 25 studies had included cases regardless of their symptoms, five studies had included asymptomatic cases only, three of which included a combination of confirmed and suspected cases. Seventy studies were conducted in Asia, 2 in Europe, 2 in North America and one in South America. Fifty-one studies included inpatients while the remaining 24 studies were conducted in mixed or unclear settings. Risk of bias was high in most studies, mainly due to concerns about selection of participants and applicability.

Among the 13 studies that included suspected cases, nine studies were conducted in Asia, and one in Europe. Seven studies included inpatients while the remaining three studies were conducted in mixed or unclear settings.

In studies that included confirmed cases the pooled sensitivity of chest CT was 93.1% (95%CI: 90.2 - 95.0 (65 studies, 5759 cases); and for X-ray 82.1% (95%CI: 62.5 to 92.7 (9 studies, 682 cases). Heterogeneity judged by visual assessment of the ROC plots was considerable. Two studies evaluated the diagnostic accuracy of point-of-care ultrasound and both reported zero false negatives (with 10 and 22 participants having undergone ultrasound, respectively). These studies only reported True Positive and False Negative data, therefore it was not possible to pool and derive estimates of specificity.

In studies that included suspected cases, the pooled sensitivity of CT was 86.2% (95%CI: 71.9 to 93.8 (13 studies, 2346 participants) and specificity was 18.1% (95%CI: 3.71 to 55.8). Heterogeneity judged by visual assessment of the forest plots was high.

Chest CT may give approximately the same proportion of positive results for patients with and without a SARS-CoV-2 infection: the chances of getting a positive CT result are 86% (95% CI: 72 to 94) in patient with a SARS-CoV-2 infection and 82% (95% CI: 44 to 96) in patients without.

Authors' conclusions

The uncertainty resulting from the poor study quality and the heterogeneity of included studies limit our ability to confidently draw conclusions based on our results. Our findings indicate that chest CT is sensitive but not specific for the diagnosis of COVID-19 in suspected patients, meaning that CT may not be capable of differentiating SARS-CoV-2 infection from other causes of respiratory illness. This low specificity could also be the result of the poor sensitivity of the reference standard (RT-PCR), as CT could potentially be more sensitive than RT-PCR in some cases. Because of limited data, accuracy estimates of chest X-ray and ultrasound of the lungs for the diagnosis of COVID-19 should be carefully interpreted.

Future diagnostic accuracy studies should avoid cases-only studies and pre-define positive imaging findings. Planned updates of this review will aim to: increase precision around the accuracy estimates for CT (ideally with low risk of bias studies); obtain further data to inform accuracy of chest X rays and ultrasound; and continue to search for studies that fulfil secondary objectives to inform the utility of imaging along different diagnostic pathways.

PLAIN LANGUAGE SUMMARY

How accurate is chest imaging for diagnosing COVID-19?

Why is this question important?

People with suspected COVID-19 need to know quickly whether they are infected, so that they can self-isolate, receive treatment, and inform close contacts. Currently, formal diagnosis of COVID-19 infection requires laboratory analysis of blood or nose and throat samples. The laboratory test, called RT-PCR, requires specialist equipment and takes at least 24 hours to produce a result. Further, RT-PCR is not completely accurate and a second RT-PCR or a different test may be required to confirm the diagnosis.

COVID-19 is a respiratory infection: people with COVID-19 may have a cough, may have difficulty breathing and in severe cases may have COVID-19 pneumonia. Clinicians use chest imaging tests to diagnose COVID-19 disease, when awaiting RT-PCR test results, for example, or when RT-PCR results are negative, and the person has COVID-19 symptoms.

We wanted to find out how accurate chest imaging is in diagnosing COVID-19 disease in people with known or suspected infection.

What are chest imaging tests?

X-rays or scans produce an image of the organs and structures (heart, lungs and airways) in the chest. They can detect blockages, inflammation and excess fluid.

- X-rays (radiography) use a small amount of radiation to produce a 2-D image. They are usually carried out in hospitals using fixed equipment by a radiographer but may also be carried out using a portable machine.

- Computed tomography (CT) scans use a computer to merge multiple X-ray images taken from different angles to produce a 2-D image that can be converted to a 3-D image. They require highly specialised equipment and are carried out in hospital by a specialist radiographer.

- Ultrasound scans use high-frequency sound waves to produce an image. They can be carried out in hospital or other healthcare settings such as a doctor's surgery or clinic.

What did we do?

We searched for studies that assessed the accuracy of chest imaging to diagnose COVID-19 disease. Studies could include people with either suspected or confirmed COVID-19, based on the results of an RT-PCR or other test. Studies could be of any design and take place anywhere.

What did we find?

We found 84 studies with 8279 people. Studies included either only people with confirmed COVID-19 diagnosis (71 studies, involving 6331 people) or both suspected and confirmed COVID-19 (13 studies, involving 1948 people). Infection was mainly confirmed using RT-PCR.

The majority of studies evaluated chest CT. We found studies from all over the world; 78 studies took place in Asia.

Accuracy of chest imaging for diagnosing COVID-19 in people with confirmed infection

On average, chest CT correctly identified infection in 93% of people with confirmed COVID-19 (65 studies, 5759 people). Chest X-ray correctly identified infection in 82% of people with confirmed COVID-19 (nine studies, 682 people). Lung ultrasound correctly identified infection in 100% of people with confirmed COVID-19 (2 studies, 32 people).

Accuracy of chest imaging for diagnosing COVID-19 in people with suspected or confirmed infection

On average, chest CT correctly identified infection in 86% of people who were infected with COVID-19 (13 studies, 2346 people). However, it incorrectly identified infection in 82% of people who were not infected with COVID-19. We did not find any studies that reported data on lung ultrasound.

How reliable are the results?

Studies reported limited information about how they confirmed COVID-19 diagnosis, how they recruited participants, and they did not always use robust methods. Most studies only included people with a confirmed COVID-19 diagnosis, so we have little information about the ability of chest imaging to rule out COVID-19 in people who are not infected. Also, studies did not report any pre-existing respiratory conditions that might have affected their results. Finally, 25% of studies were published as preprints, which do not undergo the same rigorous checks as published studies. We cannot confidently draw conclusions based on the results from studies included in this review.

What does this mean?

The evidence suggests that chest CT and chest X-ray may be good tests for confirming COVID-19 diagnosis in people who have been diagnosed with COVID-19 infection using another test. However, CT scans may be less accurate in confirming or ruling out infection in people with only suspected COVID-19.

We plan to update this review regularly as more research becomes available.

How up-to-date is this review?

The evidence in this Cochrane Review is current to May 2020.

SUMMARY OF FINDINGS

Summary of findings 1. Summary of findings table

Question	What is the diagnostic accuracy of chest imaging (computed tomography (CT), chest X-ray and ultrasound) in the evaluation of people suspected to have COVID-19?
Population	Children or adults either known to have COVID-19 or suspected to have COVID-19
Index Test	Any chest imaging test used for the diagnosis of COVID-19, including: • Chest CT • Chest x-rays • Ultrasound of the lungs
Target Condition	Detection of current COVID-19 disease
Reference Standard	A positive diagnosis for COVID-19 by: • A positive RT-PCR test for SARS-CoV-2 infection, from any manufacturer in any country, from any source, including nasopharyngeal swabs or aspirates, oropharyngeal swabs, bronchoalveolar lavage fluid (BALF), sputum, saliva, serum, urine, rectal or faecal samples. • Positive on WHO criteria for COVID-19 which includes some testing RT-PCR negative. • Positive on China CDC criteria for COVID-19 which includes some testing RT-PCR negative. • Positive serology in addition to consistent symptomatology. • Positive on study specific list of criteria for COVID-19 which includes some testing RT-PCR negative. • Other criteria (symptoms, imaging findings, other tests). A negative diagnosis for COVID-19 by: • COVID suspects with at least one negative RT-PCR. • Pre-pandemic controls (healthy or diseased). • Current healthy or with another disease (no RT-PCR test).
Limitations in the evidence	
Risk of Bias	Participant selection: high risk of bias in 57 studies (68%) Application of index tests – chest CT: high risk of bias in 10/74 studies (14%) Application of index tests – chest X-ray: high risk of bias in 2/9 studies (22%) Application of index tests – ultrasound of the lungs: high risk of bias in 1/2 studies (50%) Reference standard: high risk of bias in 12 studies (14%)

	Flow and timing: high risk of bias in 9 studies (11%)
Concerns about applicability of the evidence	Participants: high concerns in 69 studies (82%) Index test– chest CT: high concerns in 14/74studies (19%) Index test– chest X-ray: high concerns in 1/9studies (11%) Index test– ultrasound of the lungs: high concerns in 0/2 studies (0%) Reference standard: high concerns in 6 studies (7%)

Findings

- We included 84 studies with 6331 participants diagnosed with COVID-19 at the time of recruitment and 1948 participants suspected of COVID-19.
- Most studies evaluated the accuracy of chest CT scans.
- Chest CT and X-rays were highly sensitive when evaluated in confirmed cases of COVID-19.
- Chest CT was sensitive but not specific in the diagnosis of COVID-19 in suspected cases.
- Assuming that the prevalence of COVID-19 is 50%, we would expect that 69 (31 to 141) would be missed and 410 (221 to 494) would be falsely positive in 1000 people undergoing chest CT. In a high-risk setting (prevalence of 20%), 28 (12 to 56) would be missed per 1000 people tested and 655 (354 to 790) would be falsely positive. In a lower-risk setting (prevalence of 5%), 7 (3 to 14) would be missed per 1000 tested, and 778 (420 to 938) would be falsely positive.
- The evaluation of mainly confirmed cases, the low number of studies, the lack of transparent reporting, and the concerns of bias and applicability and prevent direct comparisons between different imaging modalities.

Quantity of evidence	Confirmed cases		Suspected cases		
	sensitivity (95% CI)	No. of participants (studies)	sensitivity (95% CI)	specificity (95% CI)	No. of participants (studies)
Chest CT	93.1% (95% CI: 90.2 to 95.0)	5759 (65)	86.2% (95% CI: 71.9 to 93.8)	18.1% (95% CI: 3.71 to 55.8)	2346 (13)
Chest X-ray*	82.1% (95% CI: 62.5 to 92.7)	682 (9)	-	-	-
Ultrasound of the lungs †	-	32 (2)	-	-	-

* For empty cells, no pooling was feasible due to lack of available data.
† Two studies evaluated the diagnostic accuracy of point-of-care ultrasound and both reported zero false negatives (with 10 and 22 participants having undergone ultrasound, respectively).

BACKGROUND

At the end of December 2019, Chinese public health authorities reported several cases of severe pneumonia in Wuhan City, Hubei province, due to a novel coronavirus. On 30 January 2020, the World Health Organization (WHO) declared the outbreak a global health emergency, and on 11 March 2020, a pandemic (WHO 2020). The basic reproduction number (R0) of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), as a metric for transmissibility, ranges from 2.8 to 5.5 in the absence of interventions (Read 2020).Globally, there have been more than 16,000,000 confirmed cases of COVID-19, including more than 600,000 deaths, reported to WHO (as of 26 July, 2020). The majority of symptomatic COVID-19 patients develop a mild form of the disease with dry cough, fever, or unspecific symptoms, such as headache, myalgia (muscular pain), or fatigue (Wu 2020f).The SARS-CoV-2 infection and resulting COVID-19 pandemic presents important diagnostic evaluation challenges. These include understanding the value of signs and symptoms in diagnosing possible infection, assessing whether existing biochemical and imaging tests can identify infection and those needing critical care, and evaluating whether new diagnostic tests can allow accurate rapid and point-of-care testing, either to identify or rule out current infection, identify those in need of care escalation, or to test for past infection and immunity. Current WHO guidance recommends the use of reverse transcriptase polymerase chain reaction (RT-PCR) testing for the diagnosis of COVID-19.

Decisions about patient and isolation pathways for COVID-19 vary according to health services and settings, available resources, and outbreaks in different settings. They will change over time, if and when accurate tests, effective treatments, and vaccines are identified. The decision points between these pathways vary, but all include points at which knowledge of the accuracy of diagnostic information is needed to inform medical decisions.

Therefore, it is essential to understand the accuracy of tests and diagnostic features to develop effective diagnostic and management pathways for different settings. This supports strategies aiming to identify those who are infected, and consequently the management of patients either through isolation precautions, contact tracing, quarantine, hospital admission or admission to a specialised facility, admission to the intensive care unit, or initiation of specific therapies, and implementation of mitigation strategies to limit the spread of the disease.This review from the suite of Cochrane 'living systematic reviews' summarises evidence on the accuracy of different imaging tests and diagnostic features in participants regardless of their symptoms, grouped according to the research questions and settings that we are aware of. Estimates of accuracy from this review will help inform diagnostic, screening, isolation, and patient management decisions. We have included an explanation of terminology and acronyms in Appendix 1.

Target condition being diagnosed

The target condition being evaluated is COVID-19 disease, the disease caused by infection with SARS-CoV-2. People infected with SARS-CoV-2 can be asymptomatic; these people are not considered to have COVID-19 and thus not within the scope of this review. People with COVID-19 can have a wide variety of symptoms, varying from fever, cough, aches and lethargy but without difficulty breathing at rest, to shortness of breath and increased respiratory rate, potentially requiring supplemental oxygen, and in severe cases even requiring mechanical ventilation due to severe hypoxaemic respiratory failure. Furthermore, in people diagnosed with a pulmonary condition (e.g. pulmonary embolism), symptoms could either be the explanation for the respiratory symptoms, or could be indicative of a condition that is present in addition to COVID-19 disease. In this review, we focused on persons suspected to have COVID-19 who had one or more respiratory symptoms or signs, who had chest imaging as part of their evaluation or care.

Index test(s)

Chest computed tomography (CT)

Chest CT refers to the acquisition of images of the chest using computed tomography. Typical imaging protocols would not use intravenous (IV) contrast; however, in this review we considered all variations of imaging protocols with the exception of studies specifically targeted at evaluating the coronary arteries or the heart, which did not include the entire lungs in the field of view. This includes, but is not limited to, non-contrast chest CT, low-dose chest CT (with or without contrast), high-resolution chest CT, and chest CT with IV contrast (routine or pulmonary angiogram).

Chest radiographs/chest X-rays

Chest radiography refers to evaluation of the lungs using X-rays. This often involves two orthogonal views, posterior-anterior (PA) and lateral, but may be done by portable machine and only acquire an anterior-posterior (AP) view. In this review, we considered any and all variations of chest radiography protocols that evaluated the lungs. We did not include protocols that did not include the entire thorax and were done for reasons other than for assessment of pulmonary status (e.g. assessment of feeding tube position, which typically only includes the lower thorax, or dedicated evaluation of the ribs).

Ultrasound of the lungs

Ultrasound of the lungs refers to any ultrasound of the thorax done with the intention of evaluating the status of the lungs. This includes, but is not limited to, point-of-care ultrasound (POCUS), done at the bedside by a physician, as well as what is often termed 'consultative' ultrasound, which is done by a technologist and subsequently interpreted by a physician (typically a radiologist). We considered all possible technical parameters (e.g. type of probe, transducer frequency, use of contrast). This did not include ultrasound done with the intended purpose of evaluating only the heart or vessels of the chest.

Clinical pathway

At present, the optimal diagnostic pathway and the role of chest imaging for identifying people with COVID-19 is unclear. Compared to RT-PCR testing, a potential major advantage of chest imaging is that results are available faster and that it provides a better insight into the status of the lungs. However, chest CT and ultrasound of the lungs are typically only available in secondary and tertiary healthcare settings, and availability varies across these settings.

Role of index test(s)

1. Chest imaging may play an integral role in 'ruling out' COVID-19 pneumonia when RT-PCR is unavailable, pending or negative, or

when clinical suspicion is 'low' based on other signs, symptoms and routine laboratory tests. Role of test: triage for RT-PCR, to make decisions about performing or not performing RT-PCR or other diagnostic tests.
2. Rapid testing - chest imaging is used to rule in or rule out COVID-19 when results from other tests (e.g. RT-PCR) are not available in a timely manner.
3. Concurrent/combination testing with other diagnostic tests (as part of a pair or group of tests) to improve the accuracy of diagnosis. For example, chest imaging could be used as a safety net to identify false negatives of other tests (e.g. RT-PCR), and to improve the overall accuracy of the testing strategy.

Several diagnostic pathways have been proposed that provide guidance for physicians to identify people with COVID-19. The order and components of these pathways differ with varying dependence on pre-test probability, physical exam, laboratory tests and findings based on RT-PCR results and availability. However, some professional organisations recommend imaging for patients with moderate or severe features of COVID-19 (Rubin 2020). In some hospitals, the results of low-dose chest CT are one of the many parameters (among molecular test results, routine laboratory results and clinical signs and symptoms) used to categorise patients into low risk, moderate to high risk and proven COVID-19 categories.

Given the rapid progression of COVID-19 and the constantly evolving evidence base, the diagnostic accuracy to inform the utility of chest imaging in these pathways is difficult to estimate. This 'living' systematic review aims to identify data regarding the diagnostic accuracy of chest imaging in people with suspected COVID-19. We will update this 'living' systematic review on a regular basis.

Alternative test(s)

Other Cochrane diagnostic test accuracy (DTA) Reviews in the suite of reviews are addressing the following tests.

1. Signs and symptoms, which will be mainly used in primary care, including when presenting at the emergency department (Struyf 2020)
2. Routine laboratory testing, such as for C-reactive protein (CRP) and procalcitonin (PCT)
3. Immunological tests (Deeks 2020)
4. Laboratory-independent point-of-care and near-patient molecular and antigen tests
5. Molecular laboratory tests

OBJECTIVES

The primary objective is to determine the diagnostic accuracy of chest imaging (computed tomography (CT), chest X-ray and ultrasound) in the evaluation of people suspected to have COVID-19.

Secondary objectives

1. To evaluate whether these imaging tests are sufficiently accurate to rule out COVID-19 (main measure of interest will be the negative predictive value)
2. To evaluate the rate of positive imaging in patients with initial RT-PCR negative results who have a positive result on a follow-up RT-PCR test
3. To determine if there is an association between number of days after symptom onset, symptom severity and the findings on chest imaging for patients with COVID-19
4. To determine the rate of discrepancy or agreement between CT, chest X-ray and ultrasound findings
5. To evaluate for 'threshold' effects of imaging findings of COVID-19 and accuracy measures
6. To determine the rate of alternative diagnoses identified by chest imaging

METHODS

Criteria for considering studies for this review

Types of studies

The eligibility criteria were kept broad to be able to include all patient groups and all variations of a test. Studies in which the patient population is unclear (i.e. suspected or confirmed cases) were also included.

We included studies of all designs that produced estimates of test accuracy or provided data from which estimates could be computed, for the primary objective.

We included two types of cross-sectional designs.

1. Where all patients suspected of the target condition enter the study through the same route and where it is not clear up front who has and who does not have the target condition.
2. Where the patients with the target condition and the patients without the target condition are recruited from different populations .

Unlike standard DTA reviews, in initial versions of this review we included studies focusing on patients with either confirmed or suspected COVID-19, as well as studies including patients that were either proven to have the target condition (i.e. only sensitivity was estimated) or to not have the target condition (i.e. only specificity was estimated). We presented and analysed the findings from such studies separately.

We carefully considered the limitations of different study designs in the quality assessment, the analysis, and the interpretation of findings.

Inclusion criteria

1. Study must include patients with or suspected of COVID-19 as outlined in the 'Target conditions' section. There were no age or gender restrictions.
2. Index test must be chest CT, X-ray, or ultrasound meeting the criteria described in the 'Index tests' section.
3. Index test must be interpreted by humans, and not an algorithm (machine learning/artificial intelligence (AI)).
4. A reference standard for positive and negative classification of target condition status must be applied (as outlined in the 'Reference standards' section).
5. Data must be available to extract 2 x 2 data (true positive (TP), true negative (TN), false positive (FP), false negative (FN)).

Alternatively, in studies with only target condition positive patients (TP, FN), or target condition negative patients (FP, TN), 2 x 1 data must be available. If data were not available, we contacted study authors for additional data if the study met the primary objective only (2 x 2 data).

6. Only studies including 10 or more patients who had an index test and a reference standard were included.

Participants

Our primary focus was on studies that recruited participants in either one or more of the following groups: participants suspected to have COVID-19, participants known to have COVID-19, or participants known not to have COVID-19. We included all age groups.

Index tests

Chest CT, or chest X-ray, or ultrasound of the lungs. The roles of the test can be replacement of RT-PCR, add-on test, triage test, rapid testing, or used concurrently with other diagnostic tests.

Definitions of imaging test positivity

Since COVID-19 is such a new disease, and the imaging findings were unknown until recently, there is considerable heterogeneity and change in the definitions used for positivity. Some groups have used constellations of specific findings (such as multiple peripheral ground glass opacities on CT), while others have used an approach in which they consider the combined effect of specific findings (a 'gestalt' approach). As such, we do not limit ourselves to a pre-defined threshold for, or definition of positivity. Instead, we extracted the definition for positivity used in each study, and the constellation of imaging features used to inform this definition. In this review, we considered any CT abnormality to be positive. This offers an opportunity to determine if the definition of positivity contributes to variability in accuracy.

Target conditions

As explained above, our target condition is COVID-19. However, we included all studies reporting data on COVID-19 or COVID-19 pneumonia that might provide data relevant to our objective.

Reference standards

A positive diagnosis for COVID-19 by :

1. a positive RT-PCR test for SARS-CoV-2 infection, from any manufacturer in any country, and from any sample type, including nasopharyngeal swabs or aspirates, oropharyngeal swabs, bronchoalveolar lavage fluid (BALF), sputum, saliva, serum, urine, rectal or faecal samples;
2. positive on WHO criteria for COVID-19;
3. positive on China CDC criteria for COVID-19;
4. positive serology for SARS-CoV-2 antibodies in addition to consistent symptomatology;
5. positive on study specific list of criteria for COVID-19 which includes:
   a. other criteria (symptoms, imaging findings, other tests).

A negative diagnosis for COVID-19 by:

1. COVID suspects with at least one negative RT-PCR;
2. pre-pandemic controls (healthy or diseased);
3. current healthy or with another disease (no RT-PCR test).

When studies used a variety of reference standards, we included all of them. Although RT-PCR is considered the best available test, sensitivity depends on the timing of specimen collection, with high sensitivity around the onset of symptoms and during the symptomatic period but lower sensitivity before and after that window (Kucirka 2020). Furthermore, collection of an appropriate specimen for testing can be challenging, so RT-PCR alone may not be the ideal reference standard (Li 2020g; Loeffelholz 2020). In the assessment of methodological quality, we judged how likely each reference standard definition is to correctly classify individuals. All reference standards are likely to be imperfect in some way; details of reference standard evaluation are provided in the 'Risk of bias' tool (Appendix 2). We used a consensus process to agree on the classification of the reference standard as to what we regarded as good, moderate and poor. 'Good' reference standards need to have very little chance of misclassification; 'moderate', a small but acceptable risk; and 'poor', a larger and probably unacceptable risk.

Search methods for identification of studies

Electronic searches

We used three different sources for our electronic searches, which were devised with the help of an experienced Cochrane Information Specialist with DTA expertise (RSp). These searches aimed to identify all articles related to COVID-19 and SARS-CoV-2 and were not restricted to those evaluating biomarkers. Thus, the searches used no terms that specifically focused on an index test, diagnostic accuracy or study methodology.

1. Living search from the University of Bern

We used the COVID-19 living search results of the Institute of Social and Preventive Medicine (ISPM) at the University of Bern. This search includes PubMed, Embase and preprints indexed in BioRxiv and MedRxiv databases. The strategies as described on the ISPM website (ispmbern.github.io/covid-19), are shown in Appendix 3.

2. Cochrane COVID-19 Study Register searches

We also included searches undertaken by Cochrane to develop the Cochrane COVID-19 Study Register. These include searches of trials registers at ClinicalTrials.gov and the World Health Organization International Clinical Trials Registry Platform (WHO ICTRP), as well as PubMed (see Appendix 3 for details). Search strategies were designed for maximum sensitivity, to retrieve all human studies on COVID-19. We did not apply any language limits.

3. The Stephen B. Thacker CDC Library, COVID-19 Research Articles Downloadable Database

We included Embase records within the CDC library on COVID-19 research articles database (see Appendix 3 for details) and deduplicate these against the Cochrane COVID-19 study register.

Searching other resources

We checked repositories of COVID-19 publications against these search results including the following.

1. EPPI centre eppi.ioe.ac.uk/COVID19_MAP/covid_map_v4.html.
2. Meta-evidence meta-evidence.co.uk/the-role-of-evidence-synthesis-in-covid19/.

3. From these websites we searched company and product websites for studies about test accuracy.
4. We contacted companies to ask for further information about studies.
5. We also contacted research groups that we were made aware of who are completing test evaluations (e.g. UK Public Health England-funded studies, Foundation for Innovative New Diagnostics (FIND) studies).

Data collection and analysis

Selection of studies

The review authors screened studies independently, in duplicate. A third, experienced review author resolved disagreements about initial title and abstract screening. We resolved disagreements about eligibility assessments through discussion between three review authors.

Data extraction and management

The review authors performed data extraction independently, in duplicate. Three review authors discussed any disagreements to resolve them.

Where possible, we extracted 2 x 2 contingency tables of the number of true positives, false positives, false negatives and true negative. If the studies included confirmed cases only, we extracted 2 x 1 contingency tables of the number of true positives and false negatives for only positive patients, or false positives and true negatives for only target condition negative patients.

In addition, we extracted the following items.

1. Study setting (including country), age of study participants, study dates, disease prevalence at the time of acquisition (as reported in the study), number of participants, participant symptoms, number of imaging studies (and if more than one study was done per participant), participant outcomes and other relevant participant demographic parameters.
2. Study design.
3. Imaging timing relative to disease course.
4. CT, chest X-ray and ultrasound findings.
5. Criteria for 'positive' diagnosis of COVID-19 on imaging.
6. Index test technical parameters.
7. Reference standard results and details. If RT-PCR was performed, timing of test, number of tests and method of acquisition (or similar details regarding other reference standards used).
8. Details regarding interpretation of the index test (level of training, number of readers, the inter-observer variability).
9. The number of true positives, false positives, false negatives and true negatives or summary statistics to enable their derivation.

Assessment of methodological quality

The review authors assessed the risk of bias and applicability concerns independently, in duplicate, using the QUADAS-2 checklist. Three review authors resolved any disagreements through discussion. See Appendix 2 for an explanation of the operationalisation of the four QUADAS-2 domains – participant selection, index test(s), reference standard(s), flow and timing.

Statistical analysis and data synthesis

We presented estimates of sensitivity and specificity using paired forest plots, and summarised results in tables, as appropriate. We analysed the data on a participant level, not a lesion or lung segment level, since this is what determines care.

Average sensitivities and specificities (summary points) were estimated if studies used a common threshold for test positivity. We used a bivariate model for meta-analyses, taking into account the within- and between-study variance, and the correlation between sensitivity and specificity across studies (Chu 2006; Reitsma 2005). Youden's Index (YI = sensitivity + specificity -1) was calculated when possible. We evaluated the estimates of sensitivity and specificity separately when the included studies assessed only positive patients (TP, FN), or only target condition negative patients (FP, TN). For meta-analyses of such studies we used a univariate random-effects logistic regression.

We did not undertake comparisons of test accuracy due to limited data, as 2 x 2 tables were only available for CT studies. However, in future updates, as more data become available, we will perform test comparisons using hierarchical meta-regression. We will consider using all available data regardless of whether or not studies have compared imaging modalities head-to-head in the same study population (i.e. indirect comparison), as well as restricting test comparisons to only comparative studies (i.e. direct comparisons).

We undertook meta-analyses in metandi in STATA (Harbord 2009).

Investigations of heterogeneity

We investigated heterogeneity by visual inspection of paired forest plots and SROC plots. We evaluated the impact of publication status on accuracy estimates using subgroup analyses.

Assessment of reporting bias

For this review, we did not undertake tests for publication bias and made no formal assessment of reporting bias.

Updating

With the substantial number of studies published since the latest search date of 5 May 2020, we plan to update this review shortly. We have already performed searches and completed abstract screening for the update up until 22 June 2020.

RESULTS

Results of the search

We screened 561 unique references (published or preprints) for inclusion. Of the 206 records selected for full-text assessment, we included 84 studies in this review. Refer to Figure 1 for the PRISMA flow diagram of search and inclusion results (McInnes 2018; Moher 2009). Exclusions were mainly due to ineligible study outcomes (n = 10), patient population (n = 4), or because the studies included <10 participants (n = 5). No study was identified including only confirmed target condition negative patients. The reasons for exclusion of the studies are provided in Figure 1.

Figure 1. Study flow diagram.

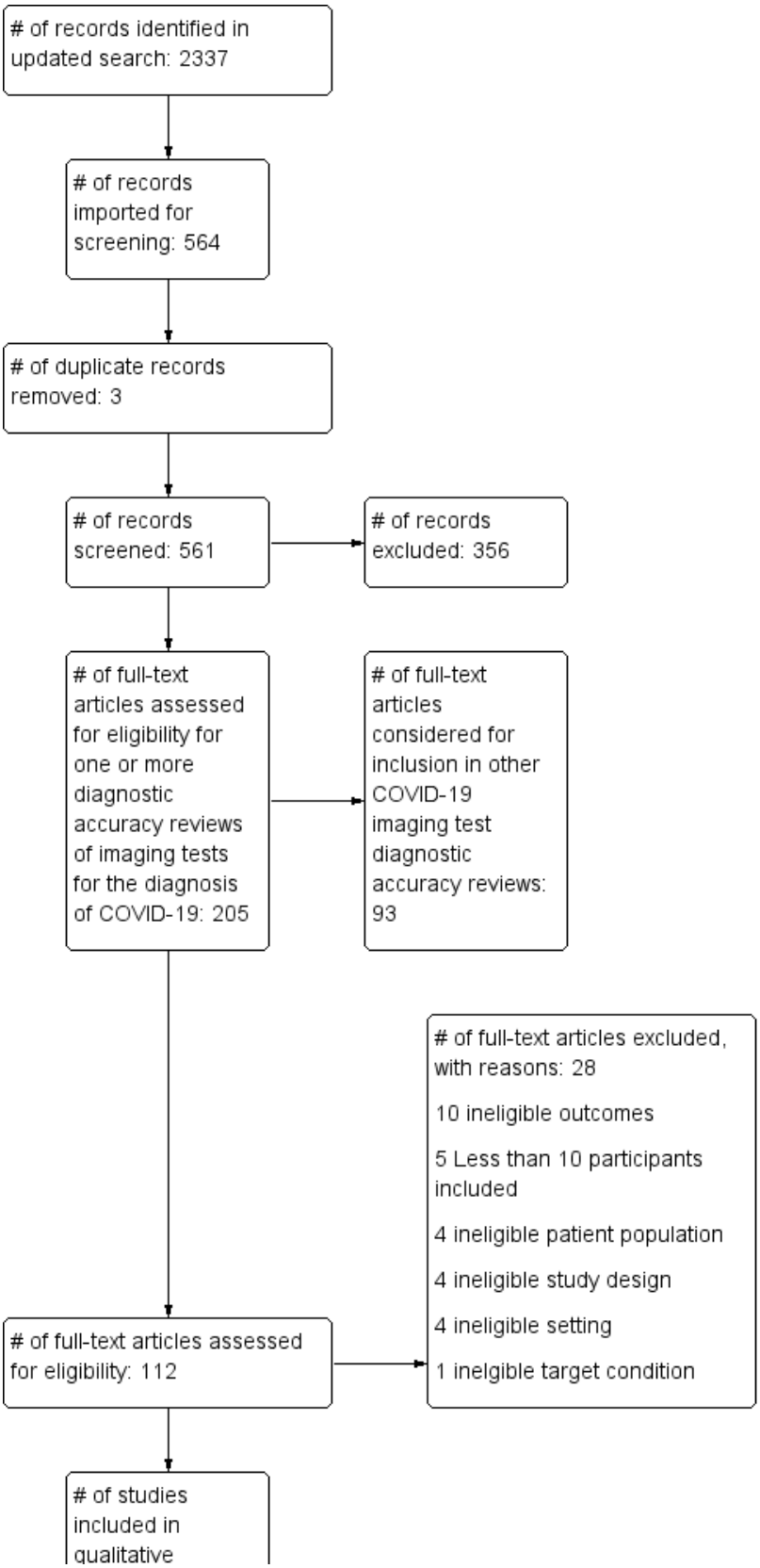
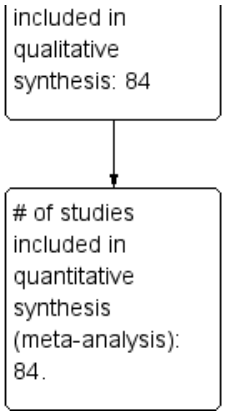


Figure 1. (Continued)



Description of included studies

Of the 84 included studies, 71 studies enrolled 6331 participants diagnosed with COVID-19 at the time of recruitment, and 10 studies recruited 1399 participants suspected of COVID-19 and three case-control studies recruited 549 cases and controls in total 1948.

Depending on the study design, included studies were pooled into two main groups for each modality. In the first group we included studies in which the authors reported chest imaging data only on patients confirmed to have COVID-19 by methods other than chest imaging (n = 71). In the second group (n = 13), we included studies in which the authors reported chest imaging data on patients with suspected as well as confirmed COVID-19 (confirmed by methods other than chest imaging) along with studies that used a case-control design to report chest imaging findings, with cases being patients with confirmed COVID-19 by methods other than chest imaging and controls being patients confirmed to not have COVID-19 by methods other than chest imaging. The median sample size was 53 (interquartile range (IQR) 28 to 102). Seventy-eight studies were conducted in Asia (China (n = 76), Japan (n = 1), and South Korea (n = 1)), three in Europe (Italy), and the remaining studies were conducted in North America (USA; n = 2) and in South America (Brazil; n = 1). The level of training of readers was not clearly reported in 40/84 studies (48%), while 43/84 studies (51%) reported that a radiologist performed the reading, and 1/84 studies (1%) was completed by residents. Techincal parameters regarding the protocol of chest CT used was not clearly reported in 59/79 (75%) studies. Non contrast CT was used in 15/79 (19%) studies, and high-resolution chest CT was used in 5/79 (6%) studies. Manuscripts of 6/13 of the studies in the suspected group and 15/71 studies in the confirmed cases group were published as preprints at the time of the search, respectively. Characteristics of the included studies are summarised inCharacteristics of included studies.

Participant characteristics

Among 71 studies including confirmed cases, 41 studies included symptomatic cases only, 25 studies included cases regardless of their symptoms, and five studies included asymptomatic cases only. Thirty-four studies included only adult participants (16 years old and over), three studies included only children, 28 studies included both children and adults, while the remaining six studies did not clearly report the age range of participants. RT-PCR was used as the reference standard for the diagnosis of COVID-19 in most of the confirmed cases studies (n = 66); with seven studies having tested each participant once, six studies twice or more, and 53 studies not reporting on the frequency of testing per participant. The remaining five studies did not clearly report the reference standard used for the diagnosis of COVID-19. Forty-seven studies included inpatients, three studies included outpatients, while the remaining 21 studies were conducted in mixed or unclear settings.

Among 13 studies including suspected cases, eight studies included only adults, two studies included only children, two studies included both children and adults, while the remaining study did not clearly report the age range of participants. RT-PCR was used as the reference standard in eight studies; with one study having tested each participant once, four studies twice or more, and three studies not reporting on the frequency of testing per participant. The remaining five studies did not clearly report the reference standard used for the diagnosis of COVID-19. Seven studies included inpatients, three studies included outpatients, and the remaining three studies were conducted in mixed or unclear setting

Index tests

Seventy-eight studies evaluated a single imaging modality, while five compared two imaging modalities, and one compared all three modalities. In total, the 84 studies reported a total of 90 imaging modality evaluations.

In the 71 confirmed cases studies, chest CT was evaluated in 60 studies, chest X-rays was evaluated in nine studies, while two studies examined the diagnostic performance of ultrasound of the lungs.

All 13 studies in suspected cases examined the diagnostic performance of chest CT alone in the diagnosis of COVID-19.

Methodological quality of included studies

Figure 2 provides a summary of the overall methodological quality assessment using the QUADAS-2 tool for all 84 included studies. Refer to Figure 3 for study-level quality assessment.

Figure 2. Risk of bias and applicability concerns graph: review authors' judgements about each domain presented as percentages across included studies

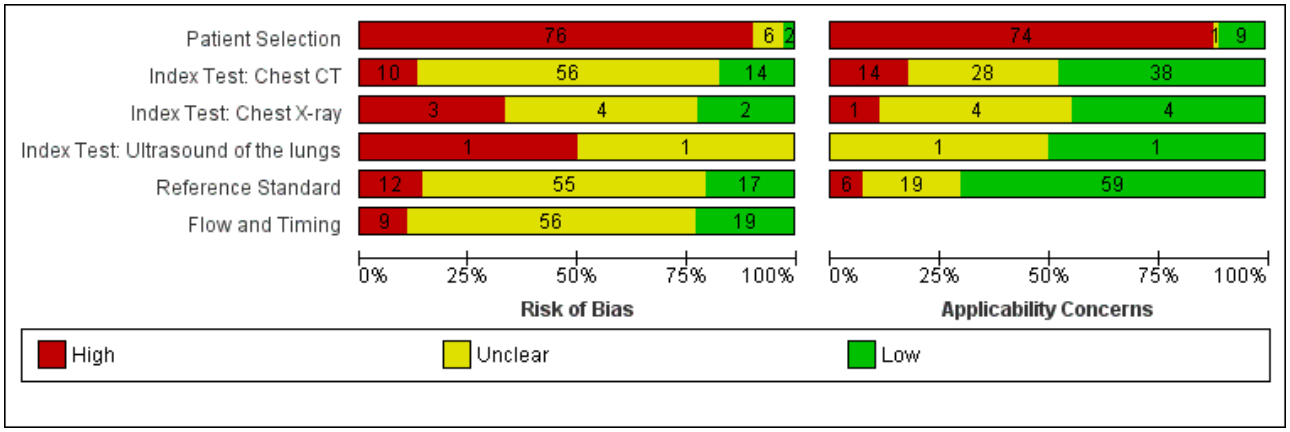


Figure 3. Risk of bias and applicability concerns summary: review authors' judgements about each domain for each included study

Figure 3. (Continued)

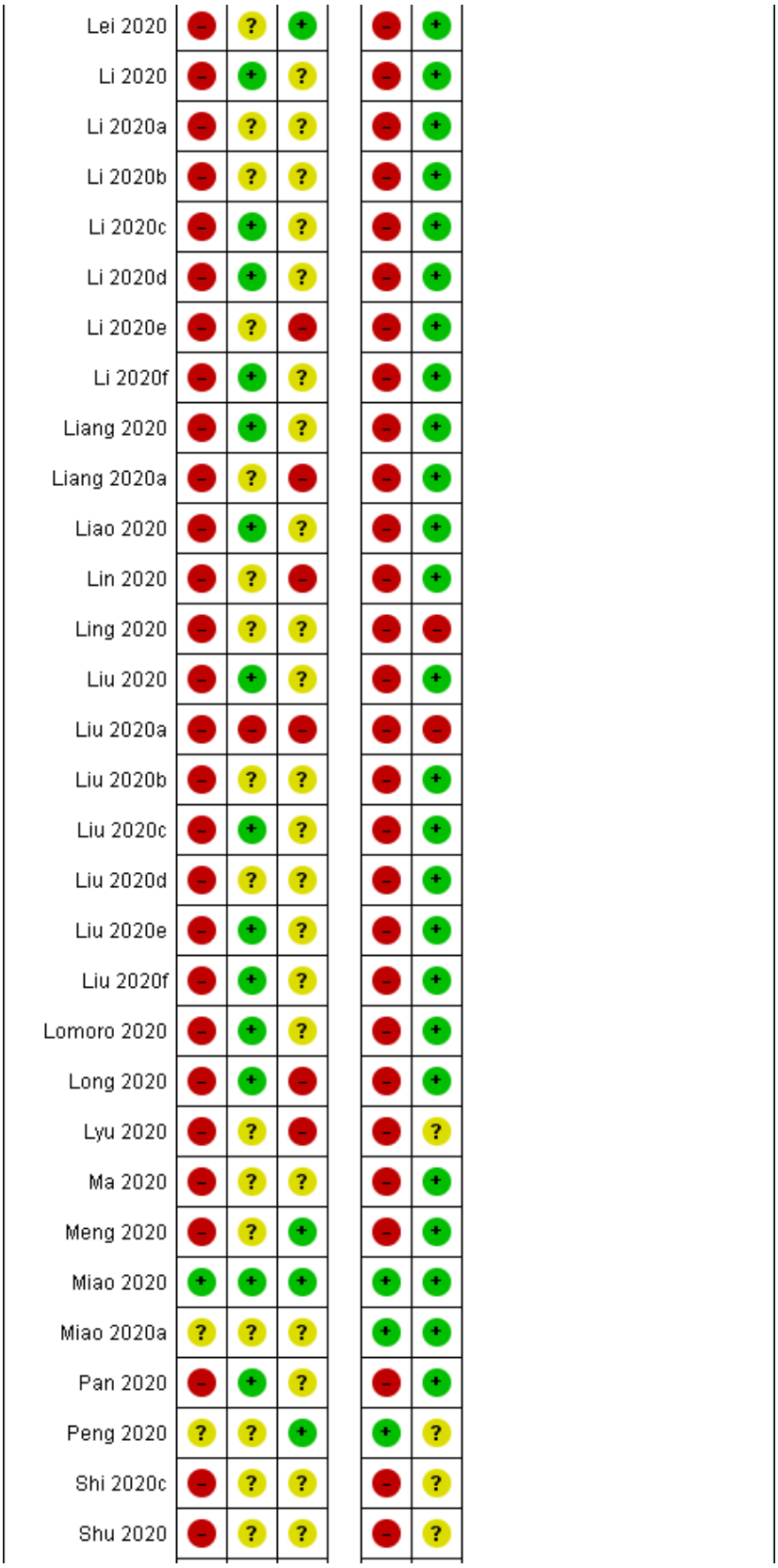


Figure 3. (Continued)

Overall, risk of bias was found to be high in 76 (90%) studies based on concerns about the selection of participants, in 10/74 (14%) studies because of concerns regarding application of chest CT, in 3/9 (33%) studies because of concerns regarding application of chest X-ray, and in 1/2 (50%) studies because of concerns about the application of ultrasound of the lungs. Risk of bias was high in 12 (14%) studies because of concerns about the reference standard, and in 9 (11%) studies because of concerns related to participant flow and timing. Concerns about the applicability of the evidence to participants were high in 74 (88%) studies. Concerns about the applicability of the evidence to the index test were high in 14/74 (19%) studies of chest CT, in 1/9 (11%) studies of chest X-ray, and in 0/2 (0%) studies of ultrasound of the lungs. Furthermore, concerns about the applicability of the evidence to the reference standard were high in six (7%) studies. Additional details about risk of bias and applicability assessment are presented in Figure 3.

In the patient selection domain, the main concern was either due to the recruitment of only COVID-19 cases (n = 71) or the use of a case-control design involving healthy or other disease controls (n = 3). In the index test domain, most of the studies did not clearly define the positivity of the imaging tests evaluated. The main concern in the reference standard domain was that most of the studies did not clearly report whether the interpretation of the reference standard was done without the knowledge of the imaging test (n=76). Finally, in the patient flow domain, most of the studies did not clearly report the time interval between the imaging test and the reference standard (n = 62), which led to high concerns.

Findings

The studies that included confirmed cases only reported TP and FN data, while those that included only suspected participants provided the 2 x 2 data points (TP/TN/FP/FN) required to pool and derive estimates of sensitivity and specificity. When the number of studies evaluating a given modality was < 4, studies were not pooled and we summarised the data qualitatively.

Pooled estimates for studies of confirmed cases

Figure 4 and Figure 5 present the forest plots of studies reporting 2 x 1 data for chest CT, and chest X-ray and ultrasound of the lungs in confirmed cases, respectively. For diagnosis of COVID-19 in confirmed cases, the sensitivities ranged between 47% and 100% for chest CT (65 studies, 5110 cases), and between 46% and 100% for X-ray (9 studies, 492 cases). The pooled sensitivity for chest CT and X-ray were 93.1% (95% CI: 90.2 to 95.0) and 82.1% (95% CI: 62.5 to 92.7), respectively.

Figure 4. Forest plot of Chest CT in confirmed cases.

Study	TP	FP	FN	TN	Publication Status	Sensitivity (95% CI)	Specificity (95% CI)
Wang 2020	14	0	16	0	Published	0.47 [0.28, 0.66]	Not estimable
Xu 2020c	5	0	5	0	Published	0.50 [0.19, 0.81]	Not estimable
Tan 2020b	5	0	5	0	Published	0.50 [0.19, 0.81]	Not estimable
Xu 2020	19	0	13	0	Pre-print	0.59 [0.41, 0.76]	Not estimable
Liao 2020	29	0	17	0	Pre-print	0.63 [0.48, 0.77]	Not estimable
Zeng 2020	46	0	22	0	Published	0.68 [0.55, 0.78]	Not estimable
Jie 2020	46	0	22	0	Published	0.68 [0.55, 0.78]	Not estimable
Wan 2020	95	0	40	0	Published	0.70 [0.62, 0.78]	Not estimable
Hu 2020	17	0	7	0	Published	0.71 [0.49, 0.87]	Not estimable
Lei 2020	10	0	4	0	Published	0.71 [0.42, 0.92]	Not estimable
Li 2020c	56	0	22	0	Published	0.72 [0.60, 0.81]	Not estimable
Tian 2020a	18	0	6	0	Pre-print	0.75 [0.53, 0.90]	Not estimable
Xu 2020a	69	0	21	0	Published	0.77 [0.67, 0.85]	Not estimable
Bernheim 2020	94	0	27	0	Published	0.78 [0.69, 0.85]	Not estimable
Xia 2020	16	0	4	0	Published	0.80 [0.56, 0.94]	Not estimable
Shu 2020	437	0	108	0	Published	0.80 [0.77, 0.83]	Not estimable
Fang 2020	50	0	11	0	Published	0.82 [0.70, 0.91]	Not estimable
Xu 2020b	41	0	9	0	Published	0.82 [0.69, 0.91]	Not estimable
Pan 2020	20	0	4	0	Published	0.83 [0.63, 0.95]	Not estimable
Chung 2020	18	0	3	0	Published	0.86 [0.64, 0.97]	Not estimable
Guan 2020a	840	0	135	0	Published	0.86 [0.84, 0.88]	Not estimable
Tian 2020	32	0	5	0	Pre-print	0.86 [0.71, 0.95]	Not estimable
Liu 2020f	68	0	10	0	Published	0.87 [0.78, 0.94]	Not estimable
Ai 2020a	90	0	12	0	Pre-print	0.88 [0.80, 0.94]	Not estimable
Yang 2020a	132	0	17	0	Published	0.89 [0.82, 0.93]	Not estimable
Guan 2020	47	0	6	0	Published	0.89 [0.77, 0.96]	Not estimable
Liu 2020b	58	0	6	0	Published	0.91 [0.81, 0.96]	Not estimable
Liu 2020d	30	0	3	0	Published	0.91 [0.76, 0.98]	Not estimable
Zhao 2020b	93	0	8	0	Published	0.92 [0.85, 0.97]	Not estimable
Wang 2020b	24	0	2	0	Published	0.92 [0.75, 0.99]	Not estimable
Liu 2020e	74	0	6	0	Pre-print	0.93 [0.84, 0.97]	Not estimable
Chen 2020	91	0	7	0	Published	0.93 [0.86, 0.97]	Not estimable
Liu 2020a	55	0	4	0	Published	0.93 [0.84, 0.98]	Not estimable
Li 2020b	30	0	2	0	Pre-print	0.94 [0.79, 0.99]	Not estimable
Li 2020a	17	0	1	0	Pre-print	0.94 [0.73, 1.00]	Not estimable
Wu 2020	76	0	4	0	Published	0.95 [0.88, 0.99]	Not estimable
Zhang 2020a	114	0	6	0	Published	0.95 [0.89, 0.98]	Not estimable
Lomoro 2020	40	0	2	0	Published	0.95 [0.84, 0.99]	Not estimable
Li 2020e	125	0	6	0	Published	0.95 [0.90, 0.98]	Not estimable
Liang 2020	84	0	4	0	Published	0.95 [0.89, 0.99]	Not estimable
Liu 2020c	70	0	3	0	Published	0.96 [0.88, 0.99]	Not estimable
Sun 2020	144	0	6	0	Published	0.96 [0.91, 0.99]	Not estimable
Li 2020f	49	0	2	0	Published	0.96 [0.87, 1.00]	Not estimable
Fu 2020	50	0	2	0	Pre-print	0.96 [0.87, 1.00]	Not estimable
Wang 2020a	50	0	2	0	Published	0.96 [0.87, 1.00]	Not estimable
Ling 2020	246	0	9	0	Published	0.96 [0.93, 0.98]	Not estimable
Huang 2020	31	0	1	0	Pre-print	0.97 [0.84, 1.00]	Not estimable
Long 2020	35	0	1	0	Published	0.97 [0.85, 1.00]	Not estimable
Zhao 2020	71	0	2	0	Pre-print	0.97 [0.90, 1.00]	Not estimable
Wang 2020c	161	0	4	0	Published	0.98 [0.94, 0.99]	Not estimable
Cao 2020	195	0	3	0	Pre-print	0.98 [0.96, 1.00]	Not estimable
Li 2020	130	0	2	0	Published	0.98 [0.95, 1.00]	Not estimable
Lin 2020	11	0	0	0	Pre-print	1.00 [0.72, 1.00]	Not estimable
Ma 2020	37	0	0	0	Pre-print	1.00 [0.91, 1.00]	Not estimable
Xiong 2020	42	0	0	0	Published	1.00 [0.92, 1.00]	Not estimable
Zhao 2020a	110	0	0	0	Published	1.00 [0.97, 1.00]	Not estimable
Zhang 2020	28	0	0	0	Published	1.00 [0.88, 1.00]	Not estimable
Chate 2020	12	0	0	0	Published	1.00 [0.74, 1.00]	Not estimable
Han 2020	108	0	0	0	Published	1.00 [0.97, 1.00]	Not estimable
Han 2020a	17	0	0	0	Published	1.00 [0.80, 1.00]	Not estimable
Li 2020d	83	0	0	0	Published	1.00 [0.96, 1.00]	Not estimable
Liu 2020	15	0	0	0	Published	1.00 [0.78, 1.00]	Not estimable
Meng 2020	58	0	0	0	Published	1.00 [0.94, 1.00]	Not estimable
Lyu 2020	51	0	0	0	Published	1.00 [0.93, 1.00]	Not estimable
Shi 2020c	81	0	0	0	Published	1.00 [0.96, 1.00]	Not estimable

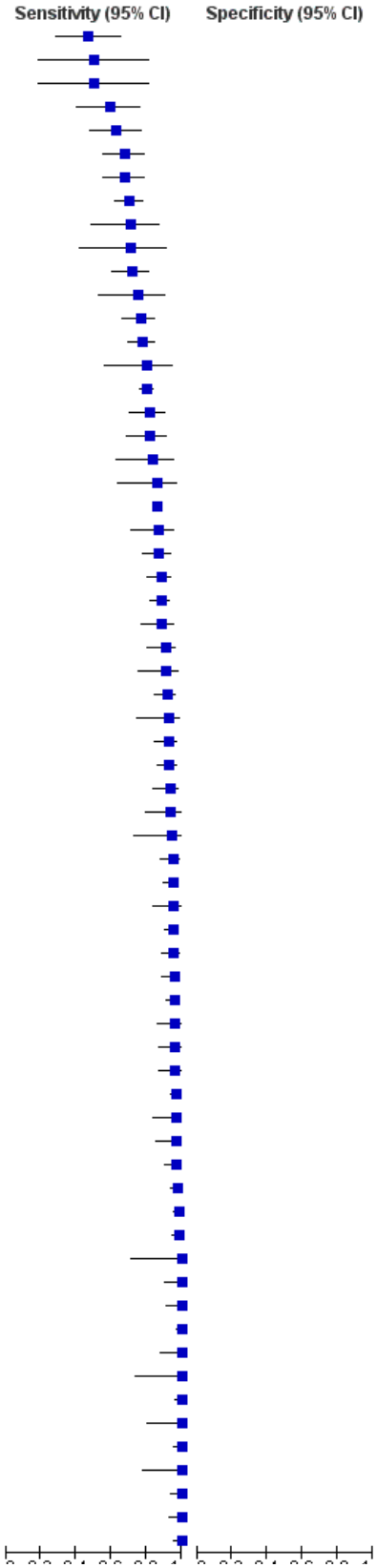


Figure 4. (Continued)

Lyu 2020	51	0	0	0	Published	1.00 [0.93, 1.00]	Not estimable
Shi 2020c	81	0	0	0	Published	1.00 [0.96, 1.00]	Not estimable

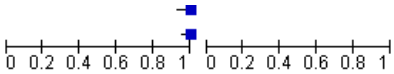
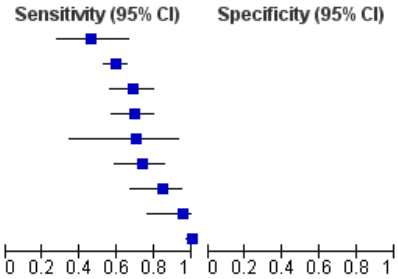


Figure 5. Forest plot of tests: Chest X-ray in confirmed cases, andUltrasound of the lungs in confirmed cases.

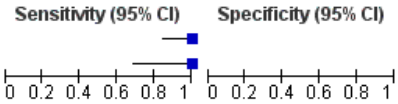
Chest X-ray in confirmed cases

Study	TP	FP	FN	TN	Publication Status	Sensitivity (95% CI)	Specificity (95% CI)
Kim 2020	13	0	15	0	Published	0.46 [0.28, 0.66]	Not estimable
Guan 2020a	162	0	112	0	Published	0.59 [0.53, 0.65]	Not estimable
Wong 2020	44	0	20	0	Published	0.69 [0.56, 0.80]	Not estimable
Gaeta 2020	50	0	22	0	Pre-print	0.69 [0.57, 0.80]	Not estimable
Xu 2020c	7	0	3	0	Published	0.70 [0.35, 0.93]	Not estimable
Wen 2020	34	0	12	0	Published	0.74 [0.59, 0.86]	Not estimable
Lomoro 2020	27	0	5	0	Published	0.84 [0.67, 0.95]	Not estimable
Arentz 2020	20	0	1	0	Published	0.95 [0.76, 1.00]	Not estimable
Wan 2020	135	0	0	0	Published	1.00 [0.97, 1.00]	Not estimable



Ultrasound of the lungs in confirmed cases

Study	TP	FP	FN	TN	Publication Status	Sensitivity (95% CI)	Specificity (95% CI)
Lomoro 2020	22	0	0	0	Published	1.00 [0.85, 1.00]	Not estimable
Yasukawa 2020	10	0	0	0	Published	1.00 [0.69, 1.00]	Not estimable



Two studies evaluated the diagnostic accuracy of point-of-care ultrasound and both reported zero false negatives (with 10 and 22 participants having undergone ultrasound, respectively).

Pooled estimates for studies of suspected cases

Figure 6 presents the forest plot of studies that reported 2 x 2 data for chest CT in suspected cases. The sensitivity and specificity of CT in the 13 studies (involving 1002 cases amongst 2346 participants) ranged between 23% and 100%, and between 0% and 99%, respectively. The pooled sensitivity and specificity for chest CT were 86.2% (95% CI: 71.9 to 93.8) and 18.1% (95% CI: 3.71 to 55.8), respectively. The scatter of the study points in ROC space on the SROC plot (Figure 7) shows substantial heterogeneity in sensitivity and specificity.

Figure 6. Forest plot of Chest CT in suspected cases.

Study	TP	FP	FN	TN	Publication Status	Sensitivity (95% CI)	Specificity (95% CI)
Bai 2020	14	64	46	141	Published	0.23 [0.13, 0.36]	0.69 [0.62, 0.75]
Caruso 2020	62	42	54	2	Published	0.53 [0.44, 0.63]	0.05 [0.01, 0.15]
Miao 2020	57	80	43	20	Pre-print	0.57 [0.47, 0.67]	0.20 [0.13, 0.29]
Peng 2020	25	13	10	20	Pre-print	0.71 [0.54, 0.85]	0.61 [0.42, 0.77]
Himoto 2020	5	2	2	13	Pre-print	0.71 [0.29, 0.96]	0.87 [0.60, 0.98]
Miao 2020a	53	76	9	0	Pre-print	0.85 [0.74, 0.93]	0.00 [0.00, 0.05]
Jiang 2020	44	19	6	0	Published	0.88 [0.76, 0.95]	0.00 [0.00, 0.18]
Yang 2020	12	40	1	2	Published	0.92 [0.64, 1.00]	0.05 [0.01, 0.16]
Xiong 2020a	19	19	1	8	Published	0.95 [0.75, 1.00]	0.30 [0.14, 0.50]
Liang 2020a	20	67	1	0	Pre-print	0.95 [0.76, 1.00]	0.00 [0.00, 0.05]
Ai 2020b	580	308	21	105	Published	0.97 [0.95, 0.98]	0.25 [0.21, 0.30]
Dong 2020a	91	1	3	72	Published	0.97 [0.91, 0.99]	0.99 [0.93, 1.00]
Ai 2020	20	20	0	13	Pre-print	1.00 [0.83, 1.00]	0.39 [0.23, 0.58]

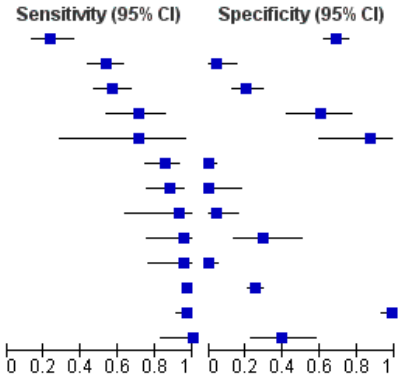
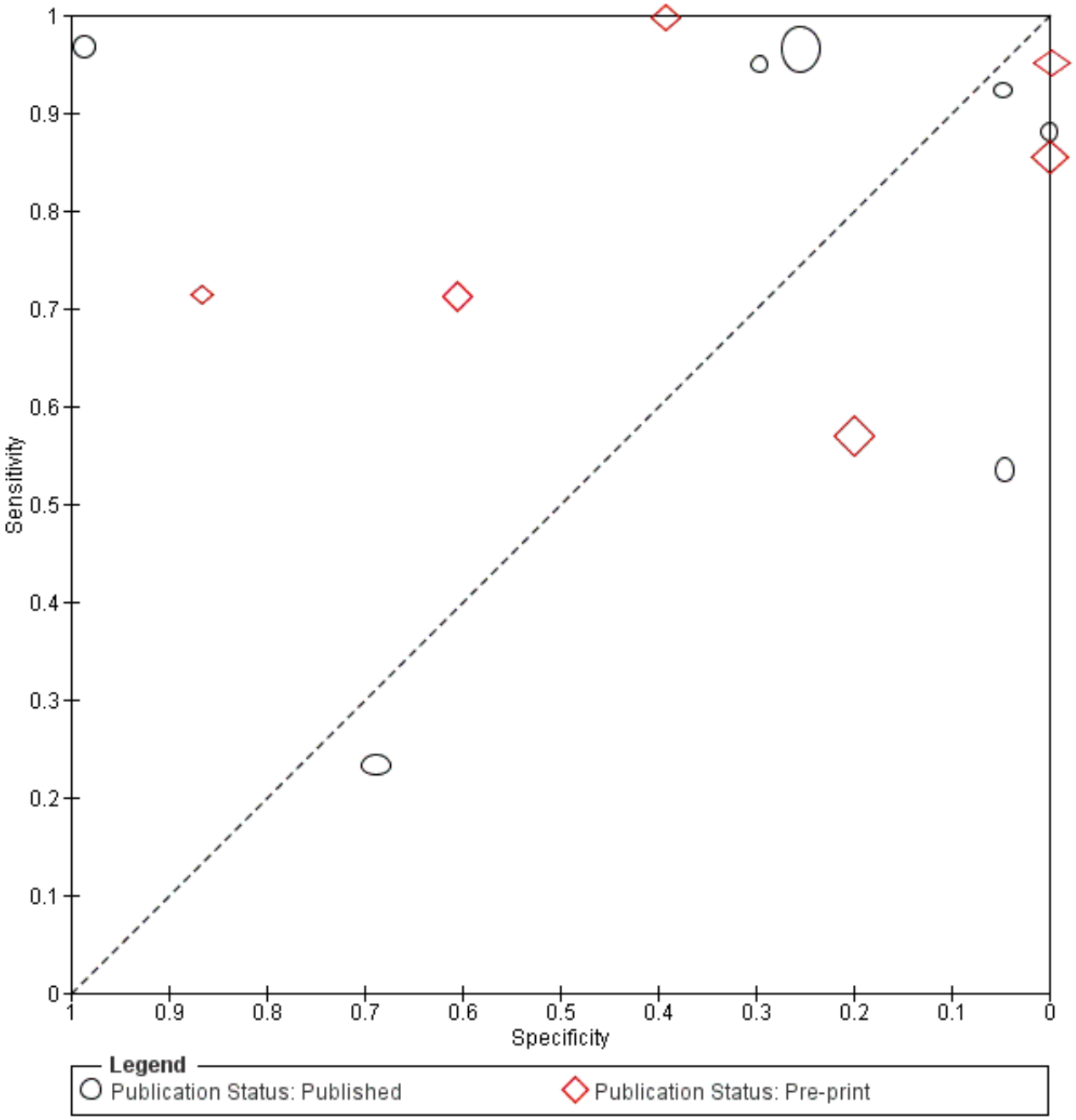


Figure 7. Summary ROC Plot of Chest CT in suspected cases.



Subgroup analyses

Among the studies with confirmed cases, subgroup analyses by publication status (pre-prints versus published studies) showed similar diagnostic accuracy estimates between the subgroups – the pooled sensitivity estimates for chest CT were 93.0% (95% CI: 86.2 to 96.6) for pre-prints versus 93.0% (95% CI: 89.9 to 95.3) for the published studies. Stratifications by risk of bias and publication status for the chest X-ray studies were not feasible because of the low number of included studies.

Among the studies with suspected cases, stratifications by risk of bias and publication status were not feasible because of the low number of included studies.

DISCUSSION

This is the first version of a Cochrane living review evaluating the diagnostic accuracy of chest imaging (computed tomography (CT), chest X-ray and ultrasound) in the evaluation of people suspected to have COVID-19. This version of the review is based on preprints and published studies up until 5 May 2020.

The rate of publication of studies evaluating the diagnostic accuracy of chest imaging for COVID-19 is atypical, and updating this review to summarise the evolving evidence is very important.

Most of the included studies (90%) in this review were conducted in China, evaluating the accuracy of various chest imaging modalities mostly in confirmed COVID-19 cases. This breakdown of participants (comprised mostly of confirmed cases) was somewhat anticipated as most of the included studies were completed during the early phases of the SARS-CoV-2 outbreak, thus recruiting mainly confirmed cases. This study design limits greatly our ability to accurately assess the diagnostic accuracy of chest CT, chest X-ray, and ultrasound of the lungs in the evaluation of suspected cases of COVID-19.

Summary of main results

- The quality of reporting and the design of the included studies affect the generalisability and reliability of our findings. The majority of included studies recruited mainly confirmed COVID-19 cases and the methods for recruiting participants and delivering the reference standard were not clearly reported. Therefore, data derived from these studies are likely at high risk of bias.
- Nearly 85% of the included studies (71/84) evaluated the diagnostic accuracy of chest imaging modalities in confirmed cases, limiting our ability to evaluate both the sensitivity and specificity of the test.
- Insufficient data are available to enable evaluation of the secondary objectives such as the impact of threshold effect (Irwig 1995), or any association between number of days after symptom onset, symptom severity and the findings on chest imaging for patients with COVID-19, which might impact the diagnostic performance of chest CT.
- There was substantial heterogeneity in the included studies, which makes the interpretation of the pooled estimates more complex. Some of the factors that may explain this heterogeneity that were not evaluated in our current version of the review might be the study design, disease prevalence, severity of participants' symptoms, definition used for positivity, different reference standards, and timing of symptom onset.
- Risk of bias was found to be high in 76 (90%) studies based on concerns about the selection of participants, in 10/74 (14%) studies because of concerns regarding application of chest CT, in 3/9 (33%) studies because of concerns regarding application of chest X-ray, and in 1/2 (50%) studies because of concerns about the application of ultrasound of the lungs. Risk of bias was high in 12 (14%) studies because of concerns about the reference standard, and in nine (11%) studies because of concerns related to participant flow and timing. Concerns about the applicability of the evidence to participants were high in 74 (88%) studies. Concerns about the applicability of the evidence to the index test were high in 14/74 (19%) studies of chest CT, in 1/9 (11%) studies of chest X-ray, and in 0/2 (0%) studies of ultrasound of the lungs. Furthermore, concerns about the applicability of the evidence to the reference standard were high in six (7%) studies. Only three studies were in outpatients, which suggests that the populations were highly selective (Struyf 2020).
- Studies with confirmed cases only reported high pooled sensitivity for chest CT and X-ray 93.1% (95% CI: 90.2 to 95.0) and 82.1% (95% CI: 62.5 to 92.7), respectively. Due to the lack of available data for point-of-care ultrasound, we were unable to derive sensitivity estimates. Direct comparisons of various imaging modalities were not possible because of the lack of data at this stage.
- In the confirmed cases studies, subgroup analyses stratified by publication status (pre-prints versus published studies) showed comparable diagnostic accuracy between estimates of the subgroups – the pooled sensitivity estimates for chest CT were 93.0% (95% CI: 86.2 to 96.6) for pre-prints versus 93.0% (95% CI: 89.9 to 95.3) for the published studies.
- Chest CT demonstrated sensitivity of 86.2% (95% CI: 71.9 to 93.8), but a low specificity of 18.1% (95% CI: 3.71 to 55.8) in the diagnosis of COVID-19 in suspected participants. A sensitivity of < 90% may not be appropriate for the evaluation of patients with suspected COVID-19' given the risk associated with false negative diagnosis; because individuals with these results may relax their measures to limit the transmission of the SARS-CoV-2 within their environment. In the case of healthcare professionals, these findings could expose their patients and colleagues to the virus, further limiting the ability of the healthcare system to effectively contain the outbreak.
- The ROC space (Figure 7) demonstrates chest CT's poor ability to discriminate between COVID and non-COVID cases. This can been seen by the equal distribution of the data points above and below the major diagonal. This is further corroborated by the Youden's Index and the comparison of the true positive rate (TPR) with the false positive rate (FPR = 1 – specificity) derived using the pooled estimates for CT. With YI = 0.04, CT gives approximately the same proportion of positive results for patients with and without a SARS-CoV-2 infection. TPR is 86%, FPR is 82%. Thus, the chances of getting a positive CT result are 86% in patient with a SARS-CoV-2 infection and 82% in patients without. Since most of the included studies do not report any pre-existing respiratory conditions in the false positive cases, our results indicate that CT is not capable of differentiating SARS-CoV-2 infection from other causes of respiratory illness in suspected patients

Strengths and weaknesses of the review

Our search strategy for identifying articles was broad and allowed for identification of a wide range of articles concerning the diagnosis of COVID-19. Record screening, data extraction, and methodological assessment were performed independently and in duplicate by the review authors. Though we are relatively confident in the accuracy and completeness of our findings, please inform us at mmcinnes@toh.ca should errors be found so that we can address them in a future update.

The quality of reporting and weaknesses in the primary studies included in this review reflect the overall robustness of our study. Several studies failed to describe their participants (e.g. recruitment setting, prevalence of COVID-19) and key information about their study design and the type of reference standard used for identifying COVID-19 cases. While the lack of rigor and quality in most of the published studies could be due to the observational nature of the initial studies published during the emergence of the coronavirus pandemic, future prospective and retrospective studies need to prioritise scientific rigor and quality.

The interpretation of the accuracy estimates in this review is difficult because of several uncertainties. First, the results of RT-PCR are not always accurate, as chest CT may be more accurate

than the reference standard in some patients. Furthermore, several included studies – particularly those of confirmed cases – did not provide specific definitions used for positivity of the imaging tests. Therefore, extraction of 2 x 1 and 2 x 2 data in this review was based on abnormality findings reported in the studies ("any abnormality" versus "no abnormality"). This assumption could lead to misclassifications of some cases. As a result, the accuracy of imaging tests in diagnosing COVID-19 is extremely setting-dependent as it is likely to be influenced by the prevalence of comparable viral pneumonias in a given setting.

A quarter of the included studies (21/84) were only available as preprint at the time of the search and had not yet been through the peer review process. Data extracted from these studies will be updated and included in future versions of our review as these studies become published in peer-reviewed journals.

Applicability of findings to the review question

Many studies in our cohort included participant who were confirmed cases. As such, the findings are less applicable to individuals suspected to have COVID-19. Our search did not identify many studies that evaluated the accuracy of chest CT, ultrasound of the lungs, and chest X-ray for the diagnosis of COVID-19 in paediatric populations. Thus, the diagnostic accuracy of these modalities in children is not known. In addition, the lack of data available in the included studies pertaining to signs and symptoms of presenting cases, the severity of the symptoms, as well as timing of symptom onset adds complexity to the interpretation of the findings in this review.

We hope that future updates of this review include more informative studies to allow for additional sources of variability to be evaluated, such as: study design, disease prevalence, participant symptoms (severity), threshold for positivity, different reference standards, timing of symptom onset and other potential candidate variables.

AUTHORS' CONCLUSIONS

Implications for practice

The uncertainty resulting from the high risk of bias and the heterogeneity of included studies limit our ability to confidently draw conclusions based on our results. Our findings indicate that chest computed tomography (CT) gives approximately the same proportion of positive results for patients with and without a SARS-CoV-2 infection: the chances of getting a positive CT result are 86% (95% CI: 72 to 94) in patient with a SARS-CoV-2 infection and 82% (95% CI: 44 to 96) in patients without. Due to the limited availability of data, accuracy estimates of chest X-ray and ultrasound of the lungs for the diagnosis of COVID-19 should be carefully interpreted. Since most of the included studies do not report any pre-existing respiratory conditions in the false positive cases, our results indicate that CT is not capable of differentiating SARS-CoV-2 infection from other causes of respiratory illness in suspected patients.

Implications for research

From our current pool of included reports, we can draw limited conclusions regarding the diagnostic performance of chest imaging modalities. Additional studies evaluating the accuracy of COVID-19 in suspected patients are needed to allow for more reliable findings. In this first version, we were unable to assess any secondary objective due to the lack of availability of the data required to evaluate direct comparisons, threshold effect, and the effect of time since onset of symptoms on the diagnostic performance of various imaging modalities. Future studies should ideally avoid cases-only studies, pre-define positive imaging findings, and include direct comparisons of the various modalities of interest on the same participant population in order to provide robust and reliable data. Furthermore, improved transparency and reporting is necessary for more efficient data extraction in our updated versions of this review. We encourage authors and investigators to refer to the STARD 2015 checklist (Bossuyt 2015) to ensure that any relevant information is clearly reported in their studies.

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CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Ai 2020

Study characteristics	
Patient Sampling	Study design: suspected patients
Patient characteristics and setting	Age group: unclear Setting: outpatient
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: any abnormality Level of training of readers: unclear Prevalence: 0.4
Target condition and reference standard(s)	Reference standard: RT-PCR twice
Flow and timing	
Comparative	
Notes	
Methodological quality	

Ai 2020 *(Continued)*

Item	Authors' judgement	Risk of bias	Applicability concerns
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	No		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	Unclear		
Could the selection of patients have introduced bias?		Unclear risk	
Are there concerns that the included patients and setting do not match the review question?			Low concern
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Yes		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			High
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Yes		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Yes		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Low risk	

Ai 2020a

Study characteristics			
Patient Sampling	Study design: symptomatic infected patients only		
Patient characteristics and setting	Age group: children and adults Setting: inpatient		
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: any abnormality Level of training of readers: unclear		
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Yes		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Unclear

Ai 2020a *(Continued)*

DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Ai 2020b

Study characteristics	
Patient Sampling	Study design: suspected patients
Patient characteristics and setting	Age group: adults only Setting: inpatient
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: unclear Level of training of readers: radiologist Prevalence: 0.6
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided
Flow and timing	
Comparative	
Notes	

Ai 2020b *(Continued)*

Methodological quality

Item	Authors' judgement	Risk of bias	Applicability concerns
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			Low concern
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	No		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		High risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Unclear
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Yes		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		

Ai 2020b *(Continued)*

Could the patient flow have introduced bias?	Low risk

Arentz 2020

Study characteristics			
Patient Sampling	Study design: symptomatic infected patients only		
Patient characteristics and setting	Age group: adults only Setting: inpatient		
Index tests	Index test(s): chest radiographs / chest X-rays Level of training of readers: unclear		
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
DOMAIN 2: Index Test (Chest X-ray)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	No		
Could the conduct or interpretation of the index test have introduced bias?		High risk	

Arentz 2020 *(Continued)*

Are there concerns that the index test, its conduct, or interpretation differ from the review question?			High
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	No		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		High risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Bai 2020

Study characteristics	
Patient Sampling	Study design: suspected and infected patients
Patient characteristics and setting	Age group: children and adults Setting: inpatient
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: unclear Level of training of readers: radiologist Prevalence: 0.2
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided
Flow and timing	
Comparative	
Notes	

Bai 2020 *(Continued)*

Methodological quality

Item	Authors' judgement	Risk of bias	Applicability concerns
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	No		
Was a case-control design avoided?	No		
Did the study avoid inappropriate exclusions?	Unclear		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Yes		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Low risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Unclear
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Yes		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	No		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		

Bai 2020 *(Continued)*

Could the patient flow have introduced bias?	High risk

Bernheim 2020

Study characteristics	
Patient Sampling	Study design: symptomatic infected patients only
Patient characteristics and setting	Age group: adults only Setting: inpatient
Index tests	Index test(s): chest CT; non contrast CT thorax Definition for positive diagnosis on CT: unclear Level of training of readers: radiologist
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided
Flow and timing	
Comparative	
Notes	

Methodological quality

Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	

Bernheim 2020 *(Continued)*

Are there concerns that the index test, its conduct, or interpretation differ from the review question?			High
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Yes		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Cao 2020

Study characteristics	
Patient Sampling	Study design: symptomatic infected patients only
Patient characteristics and setting	Age group: unclear Setting: inpatient
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: any abnormality Level of training of readers: unclear
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided
Flow and timing	
Comparative	

Cao 2020 *(Continued)*

Notes

Methodological quality

Item	Authors' judgement	Risk of bias	Applicability concerns
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Yes		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			High
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		

Cao 2020 *(Continued)*

Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Caruso 2020

Study characteristics			
Patient Sampling	Study design: suspected patients		
Patient characteristics and setting	Age group: adults only Setting: outpatient		
Index tests	Index test(s): chest CT; non contrast CT thorax Definition for positive diagnosis on CT: pneumonia Level of training of readers: radiologist Prevalence: 0.7		
Target condition and reference standard(s)	Reference standard: RT-PCR twice		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Yes		
Did the study avoid inappropriate exclusions?	Unclear		
Could the selection of patients have introduced bias?		Unclear risk	
Are there concerns that the included patients and setting do not match the review question?			Low concern
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Yes		

Caruso 2020 *(Continued)*

Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Yes		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Yes		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Low risk	

Chate 2020

Study characteristics	
Patient Sampling	Study design: symptomatic infected patients only
Patient characteristics and setting	Age group: unclear Setting: unclear
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: unclear Level of training of readers: unclear
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided
Flow and timing	

Chate 2020 *(Continued)*

Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			High
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		

Chate 2020 *(Continued)*

Did all patients receive the same reference standard?	Yes	
Were all patients included in the analysis?	Yes	
Could the patient flow have introduced bias?		Unclear risk

Chen 2020

Study characteristics			
Patient Sampling	Study design: symptomatic infected patients only		
Patient characteristics and setting	Age group: children and adults Setting: inpatient		
Index tests	Index test(s): chest CT; high resolution CT thorax Definition for positive diagnosis on CT: any abnormality Level of training of readers: radiologist		
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		

Chen 2020 *(Continued)*

If a threshold was used, was it pre-specified?	Yes		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			High
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Chung 2020

Study characteristics	
Patient Sampling	Study design: symptomatic infected patients only
Patient characteristics and setting	Age group: adults only Setting: inpatient
Index tests	Index test(s): chest CT; non contrast CT thorax Definition for positive diagnosis on CT: any abnormality Level of training of readers: radiologist
Target condition and reference standard(s)	Reference standard: unclear

Chung 2020 *(Continued)*

Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Yes		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	No		
If a threshold was used, was it pre-specified?	Yes		
Could the conduct or interpretation of the index test have introduced bias?		High risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Unclear
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Unclear
DOMAIN 4: Flow and Timing			

Chung 2020 *(Continued)*

Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Dong 2020a

Study characteristics			
Patient Sampling	Study design: suspected patients		
Patient characteristics and setting	Age group: children and adults Setting: inpatient		
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: any abnormality Level of training of readers: unclear Prevalence: 0.6		
Target condition and reference standard(s)	Reference standard: unclear		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Unclear		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	Unclear		
Could the selection of patients have introduced bias?		Unclear risk	
Are there concerns that the included patients and setting do not match the review question?			Unclear
DOMAIN 2: Index Test (Chest CT)			

Dong 2020a *(Continued)*

Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Yes		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			High
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Unclear
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Fang 2020

Study characteristics	
Patient Sampling	Study design: symptomatic infected patients only
Patient characteristics and setting	Age group: adults only Setting: inpatient
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: pneumonia Level of training of readers: unclear

Fang 2020 *(Continued)*

Target condition and reference standard(s)	Reference standard: RT-PCR twice		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Yes		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Yes		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern

Fang 2020 *(Continued)*

DOMAIN 4: Flow and Timing		
Was there an appropriate interval between index test and reference standard?	Yes	
Did all patients receive the same reference standard?	Yes	
Were all patients included in the analysis?	Yes	
Could the patient flow have introduced bias?		Low risk

Fu 2020

Study characteristics			
Patient Sampling	Study design: symptomatic infected patients only		
Patient characteristics and setting	Age group: unclear Setting: inpatient		
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: any abnormality Level of training of readers: radiologist		
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High

Fu 2020 *(Continued)*

DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Yes		
If a threshold was used, was it pre-specified?	Yes		
Could the conduct or interpretation of the index test have introduced bias?		Low risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			High
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Gaeta 2020

Study characteristics	
Patient Sampling	Study design: symptomatic infected patients only
Patient characteristics and setting	Age group: adults only Setting: inpatient
Index tests	Index test(s): chest radiographs/chest X-rays Level of training of readers: radiologist

Gaeta 2020 *(Continued)*

Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
DOMAIN 2: Index Test (Chest X-ray)			
Were the index test results interpreted without knowledge of the results of the reference standard?	No		
If a threshold was used, was it pre-specified?	No		
Could the conduct or interpretation of the index test have introduced bias?		High risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern

Gaeta 2020 *(Continued)*

DOMAIN 4: Flow and Timing		
Was there an appropriate interval between index test and reference standard?	Unclear	
Did all patients receive the same reference standard?	Yes	
Were all patients included in the analysis?	Yes	
Could the patient flow have introduced bias?		Unclear risk

Guan 2020

Study characteristics	
Patient Sampling	Study design: symptomatic infected patients only
Patient characteristics and setting	Age group: children and adults Setting: inpatient
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: pneumonia Level of training of readers: radiologist
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided
Flow and timing	
Comparative	
Notes	

Methodological quality

Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Unclear		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			

Guan 2020 *(Continued)*

Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			High
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Guan 2020a

Study characteristics	
Patient Sampling	Study design: infected patients (symptomatic and asymptomatic)
Patient characteristics and setting	Age group: children and adults Setting: unclear
Index tests	Index test(s): chest CT; chest radiographs/chest X-rays Definition for positive diagnosis on CT: ground glass opacity, local patchy shadowing, bilateral patchy shadowing, interstitial abnormalities

Guan 2020a *(Continued)*

	Level of training of readers: unclear		
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Unclear
DOMAIN 2: Index Test (Chest X-ray)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Unclear
DOMAIN 2: Index Test (Ultrasound of the lungs)			

Guan 2020a *(Continued)*

DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Yes		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Han 2020

Study characteristics	
Patient Sampling	Study design: symptomatic infected patients only
Patient characteristics and setting	Age group: adults only Setting: unclear
Index tests	Index test(s): chest CT; non contrast CT thorax Definition for positive diagnosis on CT: ground glass opacity, consolidation, vascular thickening, crazy paving pattern, air bronchograms, halo sign Level of training of readers: radiologist
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided
Flow and timing	
Comparative	
Notes	

Methodological quality

Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**

Han 2020 *(Continued)*

DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Yes		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Han 2020a

Study characteristics			
Patient Sampling	Study design: symptomatic infected patients only		
Patient characteristics and setting	Age group: adults only Setting: unclear		
Index tests	Index test(s): chest CT; non contrast CT thorax Definition for positive diagnosis on CT: ground glass opacity, consolidation (reticular and mixed) Level of training of readers: radiologist		
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Yes		
If a threshold was used, was it pre-specified?	Yes		
Could the conduct or interpretation of the index test have introduced bias?		Low risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			

Han 2020a *(Continued)*

DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Yes		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Himoto 2020

Study characteristics	
Patient Sampling	Study design: suspected patients
Patient characteristics and setting	Age group: adults only Setting: unclear
Index tests	Index test(s): chest CT; non contrast CT thorax Definition for positive diagnosis on CT: ground glass opacity (bilateral) and peripheral predominant lesions without airway abnormalities, nodules, mediastinal lymphadenopathy, pleural effusion Level of training of readers: resident Prevalence: 0.3
Target condition and reference standard(s)	Reference standard: unclear
Flow and timing	
Comparative	
Notes	
Methodological quality	

Himoto 2020 *(Continued)*

Item	Authors' judgement	Risk of bias	Applicability concerns
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Yes		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			Low concern
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Yes		
If a threshold was used, was it pre-specified?	Yes		
Could the conduct or interpretation of the index test have introduced bias?		Low risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	No		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		High risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	No		
Could the patient flow have introduced bias?		High risk	

Hu 2020

Study characteristics			
Patient Sampling	Study design: asymptomatic infected patients only		
Patient characteristics and setting	Age group: children and adults Settings: outpatient		
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: ground glass opacity, patchy shadowing, stripe shadowing Level of training of readers: unclear		
Target condition and reference standard(s)	Reference standard: RT-PCR twice		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Yes		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			

Hu 2020 *(Continued)*

DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Yes		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Yes		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Low risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Yes		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Low risk	

Huang 2020

Study characteristics			
Patient Sampling	Study design: symptomatic infected patients only		
Patient characteristics and setting	Age group: adults only Setting: inpatient		
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: pneumonia Level of training of readers: unclear		
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**

Huang 2020 *(Continued)*

DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Yes		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Low risk	

Jiang 2020

Study characteristics			
Patient Sampling	Study design: symptomatic infected patients only		
Patient characteristics and setting	Age group: adults only Setting: inpatient		
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: unclear Level of training of readers: unclear Prevalence: 0.7		
Target condition and reference standard(s)	Reference standard: RT-PCR once		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Unclear
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			

Jiang 2020 *(Continued)*

DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	No		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		High risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Jie 2020

Study characteristics			
Patient Sampling	Study design: symptomatic infected patients only		
Patient characteristics and setting	Age group: adults only Setting: unclear		
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: unclear Level of training of readers: radiologist		
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			

Jie 2020 *(Continued)*

Was a consecutive or random sample of patients enrolled?	No		
Was a case-control design avoided?	No		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Yes		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Low risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Kim 2020

Study characteristics			
Patient Sampling	Study design: infected patients (symptomatic and asymptomatic)		
Patient characteristics and setting	Age group: adults only Setting: unclear		
Index tests	Index test(s): chest CT; chest radiographs / chest X-rays Definition for positive diagnosis on CT: unclear Level of training of readers: unclear		
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	No		
Was a case-control design avoided?	Yes		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Yes		
If a threshold was used, was it pre-specified?	Yes		
Could the conduct or interpretation of the index test have introduced bias?		Low risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			

Kim 2020 *(Continued)*

Were the index test results interpreted without knowledge of the results of the reference standard?	Yes		
If a threshold was used, was it pre-specified?	Yes		
Could the conduct or interpretation of the index test have introduced bias?		Low risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Yes		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Low risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Lei 2020

Study characteristics	
Patient Sampling	Study design: symptomatic infected patients only
Patient characteristics and setting	Age group: children and adults Setting: unclear
Index tests	Index test(s): chest CT; non contrast CT thorax Definition for positive diagnosis on CT: unclear Level of training of readers: radiologist
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided

Lei 2020 *(Continued)*

Flow and timing
Comparative
Notes

Methodological quality

Item	Authors' judgement	Risk of bias	Applicability concerns
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	No		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Yes		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			

Lei 2020 *(Continued)*

Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Low risk	

Li 2020

Study characteristics			
Patient Sampling	Study design: symptomatic infected patients only		
Patient characteristics and setting	Age group: adults only Setting: unclear		
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: unclear Level of training of readers: unclear		
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	No		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			

Li 2020 *(Continued)*

Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Yes		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Low risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Yes		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Li 2020a

Study characteristics	
Patient Sampling	Study design: infected patients (symptomatic and asymptomatic)
Patient characteristics and setting	Age group: adults only Setting: inpatient
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: any abnormality

Li 2020a *(Continued)*

	Level of training of readers: unclear		
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Yes		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			High
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Yes		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	

Li 2020a *(Continued)*

Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Li 2020b

Study characteristics	
Patient Sampling	Study design: symptomatic infected patients only
Patient characteristics and setting	Age group: adults only Setting: unclear
Index tests	Index test(s): chest CT; high resolution CT thorax Definition for positive diagnosis on CT: unclear Level of training of readers: unclear
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided
Flow and timing	
Comparative	
Notes	

Methodological quality

Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Yes		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	

Li 2020b *(Continued)*

Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			High
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Yes		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Li 2020c

Study characteristics	
Patient Sampling	Study design: infected patients (symptomatic and asymptomatic)
Patient characteristics and setting	Age group: adults only Setting: unclear

Li 2020c *(Continued)*

Index tests	Index test(s): chest CT; non contrast CT thorax Definition for positive diagnosis on CT: other Level of training of readers: radiologist
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided
Flow and timing	
Comparative	
Notes	

Methodological quality

Item	Authors' judgement	Risk of bias	Applicability concerns
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	No		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Yes		
If a threshold was used, was it pre-specified?	Yes		
Could the conduct or interpretation of the index test have introduced bias?		Low risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Yes		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		

Li 2020c *(Continued)*

Could the reference standard, its conduct, or its interpretation have introduced bias?		Low risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Yes		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Li 2020d

Study characteristics	
Patient Sampling	Study design: symptomatic infected patients only
Patient characteristics and setting	Age group: unclear Setting: unclear
Index tests	Index test(s): chest CT; non contrast CT thorax Definition for positive diagnosis on CT: ground glass opacity, consolidation, nodule, reticulation, interlobular septal thickening, crazy paving pattern, linear opacities, subpleural curvilinear line, bronchial wall thickening, lymph node enlargement, pleural effusion, pericardial effusion Level of training of readers: radiologist
Target condition and reference standard(s)	Reference standard: other
Flow and timing	
Comparative	
Notes	

Methodological quality

Item	Authors' judgement	Risk of bias	Applicability concerns
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	No		

Li 2020d *(Continued)*

Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Yes		
If a threshold was used, was it pre-specified?	No		
Could the conduct or interpretation of the index test have introduced bias?		Low risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Yes		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Low risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Yes		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Li 2020e

Study characteristics

Li 2020e *(Continued)*

Patient Sampling	Study design: symptomatic infected patients only
Patient characteristics and setting	Age group: adults only Setting: unclear
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: unclear Level of training of readers: radiologist
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided
Flow and timing	
Comparative	
Notes	

Methodological quality

Item	Authors' judgement	Risk of bias	Applicability concerns
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Unclear		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	No		
Could the conduct or interpretation of the index test have introduced bias?		High risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			High
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			

Li 2020e *(Continued)*

Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		High risk	

Li 2020f

Study characteristics	
Patient Sampling	Study design: symptomatic infected patients only
Patient characteristics and setting	Age group: adults only Setting: unclear
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: unclear Level of training of readers: radiologist
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided
Flow and timing	
Comparative	
Notes	

Methodological quality

Item	Authors' judgement	Risk of bias	Applicability concerns
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	No		

Li 2020f *(Continued)*

Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Unclear
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Yes		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Low risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Yes		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Liang 2020

Study characteristics

Liang 2020 *(Continued)*

Patient Sampling	Study design: infected patients (symptomatic and asymptomatic)
Patient characteristics and setting	Age group: children and adults Setting: unclear
Index tests	Index test(s): chest CT; non contrast CT thorax Definition for positive diagnosis on CT: unclear Level of training of readers: radiologist
Target condition and reference standard(s)	Reference standard: RT-PCR once
Flow and timing	
Comparative	
Notes	

Methodological quality

Item	Authors' judgement	Risk of bias	Applicability concerns
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	No		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			

Liang 2020 *(Continued)*

Is the reference standards likely to correctly classify the target condition?	Yes		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Low risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Yes		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Liang 2020a

Study characteristics			
Patient Sampling	Study design: suspected and infected patients		
Patient characteristics and setting	Age group: adults only Setting: unclear		
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: unclear Level of training of readers: unclear Prevalence: 0.2		
Target condition and reference standard(s)	Reference standard: unclear		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			

Liang 2020a *(Continued)*

Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	No		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	No		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		High risk	

Liao 2020

Study characteristics			
Patient Sampling	Study design: symptomatic infected patients only		
Patient characteristics and setting	Age group: children and adults Setting: unclear		
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: unclear Level of training of readers: unclear		
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	No		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			

Liao 2020 *(Continued)*

DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Yes		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Low risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Lin 2020

Study characteristics			
Patient Sampling	Study design: infected patients (symptomatic and asymptomatic)		
Patient characteristics and setting	Age group: adults only Setting: inpatient		
Index tests	Index test(s): chest CT; high resolution CT thorax Definition for positive diagnosis on CT: pneumonia Level of training of readers: radiologist		
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**

Lin 2020 *(Continued)*

DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	No		
Could the conduct or interpretation of the index test have introduced bias?		High risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			High
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Yes		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		High risk	

Ling 2020

Study characteristics			
Patient Sampling	Study design: infected patients (symptomatic and asymptomatic)		
Patient characteristics and setting	Age group: unclear Setting: unclear		
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: unclear Level of training of readers: unclear		
Target condition and reference standard(s)	Reference standard: RT-PCR twice		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	No		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Yes		
Could the conduct or interpretation of the index test have introduced bias?		Low risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			

Ling 2020 *(Continued)*

DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			High
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	No		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Liu 2020

Study characteristics	
Patient Sampling	Study design: symptomatic infected patients only
Patient characteristics and setting	Age group: adults only Setting: unclear
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: unclear Level of training of readers: radiologist
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided
Flow and timing	
Comparative	
Notes	

Methodological quality

Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			

Liu 2020 *(Continued)*

Was a consecutive or random sample of patients enrolled?	No		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Yes		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Yes		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Low risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	No		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Liu 2020a

Study characteristics			
Patient Sampling	Study design: infected patients (symptomatic and asymptomatic)		
Patient characteristics and setting	Age group: children and adults Setting: unclear		
Index tests	Index test(s): chest CT; non contrast CT thorax Definition for positive diagnosis on CT: unclear Level of training of readers: radiologist		
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	No		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			

Liu 2020a *(Continued)*

DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	No		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		High risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			High
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	No		
Were all patients included in the analysis?	Unclear		
Could the patient flow have introduced bias?		High risk	

Liu 2020b

Study characteristics	
Patient Sampling	Study design: infected patients (symptomatic and asymptomatic)
Patient characteristics and setting	Age group: adults only Setting: inpatient
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: any abnormality Level of training of readers: radiologist
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided
Flow and timing	
Comparative	
Notes	
Methodological quality	

Liu 2020b *(Continued)*

Item	Authors' judgement	Risk of bias	Applicability concerns
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Unclear
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Yes		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Liu 2020c

Study characteristics			
Patient Sampling	Study design: symptomatic infected patients only		
Patient characteristics and setting	Age group: children and adults Setting: unclear		
Index tests	Index test(s): chest CT; high resolution CT thorax Definition for positive diagnosis on CT: unclear Level of training of readers: radiologist		
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	No		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			

Liu 2020c *(Continued)*

DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Yes		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Low risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Liu 2020d

Study characteristics	
Patient Sampling	Study design: infected patients (symptomatic and asymptomatic)
Patient characteristics and setting	Age group: adults only Setting: inpatient
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: pneumonia Level of training of readers: unclear
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided
Flow and timing	
Comparative	
Notes	
Methodological quality	

Liu 2020d *(Continued)*

Item	Authors' judgement	Risk of bias	Applicability concerns
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	No		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Liu 2020e

Study characteristics			
Patient Sampling	Study design: symptomatic infected patients only		
Patient characteristics and setting	Age group: adults only Setting: unclear		
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: unclear Level of training of readers: unclear		
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	No		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			

Liu 2020e *(Continued)*

DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Yes		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Low risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Yes		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Liu 2020f

Study characteristics			
Patient Sampling	Study design: symptomatic infected patients only		
Patient characteristics and setting	Age group: children and adults Setting: inpatient		
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: unclear Level of training of readers: unclear		
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**

Liu 2020f *(Continued)*

DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Unclear
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Yes		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Low risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Lomoro 2020

Study characteristics			
Patient Sampling	Study design: symptomatic infected patients only		
Patient characteristics and setting	Age group: adults only Setting: unclear		
Index tests	Index test(s): chest CT; chest radiographs / chest X-rays; ultrasound of the lungs (POCUS); non contrast CT thorax Definition for positive diagnosis on CT: unclear Level of training of readers: radiologist		
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	No		
Was a case-control design avoided?	Yes		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Unclear
DOMAIN 2: Index Test (Chest X-ray)			

Lomoro 2020 *(Continued)*

Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Unclear
DOMAIN 2: Index Test (Ultrasound of the lungs)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Unclear
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Yes		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Low risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Yes		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Long 2020

Study characteristics	
Patient Sampling	Study design: suspected and infected patients
Patient characteristics and setting	Age group: adults only

Long 2020 *(Continued)*

	Setting: inpatient		
Index tests	Index test(s): chest CT; non contrast CT thorax Definition for positive diagnosis on CT: unclear Level of training of readers: radiologist		
Target condition and reference standard(s)	Reference standard: RT-PCR twice		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	No		
Was a case-control design avoided?	No		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Yes		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		

Long 2020 *(Continued)*

Could the reference standard, its conduct, or its interpretation have introduced bias?		Low risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Yes		
Did all patients receive the same reference standard?	No		
Were all patients included in the analysis?	Unclear		
Could the patient flow have introduced bias?		High risk	

Lyu 2020

Study characteristics	
Patient Sampling	Study design: symptomatic infected patients only
Patient characteristics and setting	Age group: adults only Setting: inpatient
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: other Level of training of readers: radiologist
Target condition and reference standard(s)	Reference standard: unclear
Flow and timing	
Comparative	
Notes	

Methodological quality

Item	Authors' judgement	Risk of bias	Applicability concerns
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	No		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	

Lyu 2020 *(Continued)*

Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Yes		
If a threshold was used, was it pre-specified?	No		
Could the conduct or interpretation of the index test have introduced bias?		High risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Unclear
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	No		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		High risk	

Ma 2020

Study characteristics	
Patient Sampling	Study design: infected patients (symptomatic and asymptomatic)
Patient characteristics and setting	Age group: adults only Setting: outpatient

Ma 2020 *(Continued)*

Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: unclear Level of training of readers: unclear		
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		

Ma 2020 *(Continued)*

Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Meng 2020

Study characteristics	
Patient Sampling	Study design: asymptomatic infected patients only
Patient characteristics and setting	Age group: adults only Setting: inpatient
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: unclear Level of training of readers: radiologist
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided
Flow and timing	
Comparative	
Notes	

Methodological quality

Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	No		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		

Meng 2020 *(Continued)*

Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Yes		
If a threshold was used, was it pre-specified?	Yes		
Could the conduct or interpretation of the index test have introduced bias?		Low risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Yes		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Low risk	

Miao 2020

Study characteristics	
Patient Sampling	Study design: suspected patients
Patient characteristics and setting	Age group: adults only Setting: inpatient

Miao 2020 *(Continued)*

Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: ground glass opacity with bilateral pulmonary distribution Level of training of readers: unclear Prevalence: 0.5		
Target condition and reference standard(s)	Reference standard: RT-PCR twice		
Flow and timing			
Comparative			
Notes			

Methodological quality

Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Yes		
Did the study avoid inappropriate exclusions?	Yes		
Could the selection of patients have introduced bias?		Low risk	
Are there concerns that the included patients and setting do not match the review question?			Low concern
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Yes		

Miao 2020 *(Continued)*

Were the reference standard results interpreted without knowledge of the results of the index tests?	Yes		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Low risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Yes		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Low risk	

Miao 2020a

Study characteristics			
Patient Sampling	Study design: suspected patients		
Patient characteristics and setting	Age group: adults only Setting: outpatient		
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: unclear Level of training of readers: radiologist Prevalence: 0.4		
Target condition and reference standard(s)	Reference standard: RT-PCR once		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		

Miao 2020a *(Continued)*

Was a case-control design avoided?	Yes		
Did the study avoid inappropriate exclusions?	Unclear		
Could the selection of patients have introduced bias?		Unclear risk	
Are there concerns that the included patients and setting do not match the review question?			Low concern
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Yes		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Pan 2020

Study characteristics

Pan 2020 *(Continued)*

Patient Sampling	Study design: symptomatic infected patients only
Patient characteristics and setting	Age group: adults only Setting: inpatient
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: unclear Level of training of readers: radiologist
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided
Flow and timing	
Comparative	
Notes	

Methodological quality

Item	Authors' judgement	Risk of bias	Applicability concerns
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	No		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Yes		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			

Pan 2020 *(Continued)*

Is the reference standards likely to correctly classify the target condition?	Yes		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Low risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Peng 2020

Study characteristics	
Patient Sampling	Study design: suspected patients
Patient characteristics and setting	Age group: children only Setting: inpatient
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: ground glass opacity, consolidations with surrounding halo sign, nodules, residual fiber strips, lymphadenopathy Level of training of readers: radiologist Prevalence: 0.5
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided
Flow and timing	
Comparative	
Notes	

Methodological quality

Item	Authors' judgement	Risk of bias	Applicability concerns

Peng 2020 *(Continued)*

DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	Yes		
Could the selection of patients have introduced bias?		Unclear risk	
Are there concerns that the included patients and setting do not match the review question?			Low concern
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Unclear
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Yes		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Low risk	

Shi 2020c

Study characteristics			
Patient Sampling	Study design: symptomatic infected patients only		
Patient characteristics and setting	Age group: children and adults Setting: inpatient		
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: any abnormality Level of training of readers: radiologist		
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Unclear
DOMAIN 2: Index Test (Chest X-ray)			

Shi 2020c *(Continued)*

DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Yes		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Unclear
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Shu 2020

Study characteristics	
Patient Sampling	Study design: symptomatic infected patients only
Patient characteristics and setting	Age group: children and adults Setting: inpatient
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: any abnormality Level of training of readers: unclear
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided
Flow and timing	
Comparative	
Notes	
Methodological quality	

Shu 2020 *(Continued)*

Item	Authors' judgement	Risk of bias	Applicability concerns
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Unclear
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Unclear
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Sun 2020

Study characteristics			
Patient Sampling	Study design: symptomatic infected patients only		
Patient characteristics and setting	Age group: children and adults Setting: inpatient		
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: pneumonia Level of training of readers: unclear		
Target condition and reference standard(s)	Reference standard: RT-PCR once		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Unclear
DOMAIN 2: Index Test (Chest X-ray)			

Sun 2020 *(Continued)*

DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	No		
Could the reference standard, its conduct, or its interpretation have introduced bias?		High risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Yes		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Low risk	

Tan 2020b

Study characteristics	
Patient Sampling	Study design: infected patients (symptomatic and asymptomatic)
Patient characteristics and setting	Age group: children only Setting: inpatient
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: ground glass opacity or bronchopneumonia Level of training of readers: unclear
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided
Flow and timing	
Comparative	
Notes	
Methodological quality	

Tan 2020b *(Continued)*

Item	Authors' judgement	Risk of bias	Applicability concerns
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Unclear
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Unclear
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Tian 2020

Study characteristics			
Patient Sampling	Study design: infected patients (symptomatic and asymptomatic)		
Patient characteristics and setting	Age group: children and adults Setting: inpatient		
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: pneumonia Level of training of readers: unclear		
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Unclear

Tian 2020 *(Continued)*

DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Unclear		
Were all patients included in the analysis?	Unclear		
Could the patient flow have introduced bias?		Unclear risk	

Tian 2020a

Study characteristics	
Patient Sampling	Study design: asymptomatic infected patients only
Patient characteristics and setting	Age group: unclear Setting: outpatient
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: bilateral infiltration Level of training of readers: unclear
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided
Flow and timing	
Comparative	
Notes	
Methodological quality	

Tian 2020a *(Continued)*

Item	Authors' judgement	Risk of bias	Applicability concerns
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	No		
Was a case-control design avoided?	No		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Unclear
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Unclear
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Wan 2020

Study characteristics			
Patient Sampling	Study design: asymptomatic infected patients only		
Patient characteristics and setting	Age group: adults only Setting: inpatient		
Index tests	Index test(s): chest CT; chest radiographs / chest X-rays Definition for positive diagnosis on CT: any abnormality Level of training of readers: unclear		
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	No		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern

Wan 2020 *(Continued)*

DOMAIN 2: Index Test (Chest X-ray)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Unclear
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Unclear		
Were all patients included in the analysis?	Unclear		
Could the patient flow have introduced bias?		Unclear risk	

Wang 2020

Study characteristics	
Patient Sampling	Study design: symptomatic infected patients only
Patient characteristics and setting	Age group: children and adults Setting: inpatient
Index tests	Index test(s): chest CT; chest radiographs / chest X-rays Definition for positive diagnosis on CT: any abnormality

Wang 2020 *(Continued)*

	Level of training of readers: unclear		
Target condition and reference standard(s)	Reference standard: RT-PCR once		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Yes		
Could the conduct or interpretation of the index test have introduced bias?		Low risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Yes		
Could the conduct or interpretation of the index test have introduced bias?		Low risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			

Wang 2020 *(Continued)*

Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Low risk	

Wang 2020a

Study characteristics	
Patient Sampling	Study design: symptomatic infected patients only
Patient characteristics and setting	Age group: children and adults Setting: inpatient
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: any abnormality Level of training of readers: radiologist
Target condition and reference standard(s)	Reference standard: RT-PCR once
Flow and timing	
Comparative	
Notes	

Methodological quality

Item	Authors' judgement	Risk of bias	Applicability concerns
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		

Wang 2020a *(Continued)*

Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	No		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		High risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Yes		
Were the reference standard results interpreted without knowledge of the results of the index tests?	No		
Could the reference standard, its conduct, or its interpretation have introduced bias?		High risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Yes		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Low risk	

Wang 2020b

Study characteristics

Wang 2020b *(Continued)*

Patient Sampling	Study design: symptomatic infected patients only
Patient characteristics and setting	Age group: children and adults Setting: inpatient
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: pneumonia Level of training of readers: unclear
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided
Flow and timing	
Comparative	
Notes	

Methodological quality

Item	Authors' judgement	Risk of bias	Applicability concerns
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Unclear
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			

Wang 2020b *(Continued)*

Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Unclear
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Wang 2020c

Study characteristics			
Patient Sampling	Study design: infected patients (symptomatic and asymptomatic)		
Patient characteristics and setting	Age group: adults only Setting: inpatient		
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: any abnormality Level of training of readers: unclear		
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			

Wang 2020c *(Continued)*

Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Unclear
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Unclear
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Wen 2020

Study characteristics			
Patient Sampling	Study design: symptomatic infected patients only		
Patient characteristics and setting	Age group: children and adults Setting: inpatient		
Index tests	Index test(s): chest radiographs / chest X-rays Level of training of readers: unclear		
Target condition and reference standard(s)	Reference standard: RT-PCR once		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
DOMAIN 2: Index Test (Chest X-ray)			
Were the index test results interpreted without knowledge of the results of the reference standard?	No		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		High risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			

Wen 2020 *(Continued)*

Is the reference standards likely to correctly classify the target condition?	Yes		
Were the reference standard results interpreted without knowledge of the results of the index tests?	No		
Could the reference standard, its conduct, or its interpretation have introduced bias?		High risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Yes		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Low risk	

Wong 2020

Study characteristics	
Patient Sampling	Study design: infected patients (symptomatic and asymptomatic)
Patient characteristics and setting	Age group: adults only Setting: inpatient
Index tests	Index test(s): chest radiographs / chest X-rays Level of training of readers: radiologist
Target condition and reference standard(s)	Reference standard: RT-PCR twice
Flow and timing	
Comparative	
Notes	

Methodological quality

Item	Authors' judgement	Risk of bias	Applicability concerns
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		

Wong 2020 *(Continued)*

Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Unclear
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Yes		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Low risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Yes		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Low risk	

Wu 2020

Study characteristics	
Patient Sampling	Study design: symptomatic infected patients only
Patient characteristics and setting	Age group: children and adults

Wu 2020 *(Continued)*

	Setting: inpatient		
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: any abnormality Level of training of readers: radiologist		
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided		
Flow and timing			
Comparative			
Notes			

Methodological quality

Item	Authors' judgement	Risk of bias	Applicability concerns
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Yes		
If a threshold was used, was it pre-specified?	Yes		
Could the conduct or interpretation of the index test have introduced bias?		Low risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		

Wu 2020 *(Continued)*

Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Unclear
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Xia 2020

Study characteristics	
Patient Sampling	Study design: infected patients (symptomatic and asymptomatic)
Patient characteristics and setting	Age group: children only Setting: inpatient
Index tests	Index test(s): chest CT; non contrast CT thorax Definition for positive diagnosis on CT: any abnormality Level of training of readers: radiologist
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided
Flow and timing	
Comparative	
Notes	

Methodological quality

Item	Authors' judgement	Risk of bias	Applicability concerns
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		

Xia 2020 *(Continued)*

Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Unclear
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Unclear
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Xiong 2020

Study characteristics

Xiong 2020 *(Continued)*

Patient Sampling	Study design: symptomatic infected patients only
Patient characteristics and setting	Age group: children and adults Setting: inpatient
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: any abnormality Level of training of readers: radiologist
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided
Flow and timing	
Comparative	
Notes	

Methodological quality

Item	Authors' judgement	Risk of bias	Applicability concerns
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Unclear
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			

Xiong 2020 *(Continued)*

DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Unclear
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Xiong 2020a

Study characteristics	
Patient Sampling	Study design: suspected patients
Patient characteristics and setting	Age group: children and adults Setting: inpatient
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: subpleural ground glass opacity without pleural effusion, bronchial changes or lymphadenopathy Level of training of readers: radiologist Prevalence: 0.4
Target condition and reference standard(s)	Reference standard: unclear
Flow and timing	
Comparative	
Notes	

Methodological quality

Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**

Xiong 2020a *(Continued)*

DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Yes		
Did the study avoid inappropriate exclusions?	Unclear		
Could the selection of patients have introduced bias?		Low risk	
Are there concerns that the included patients and setting do not match the review question?			Low concern
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Unclear
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	No		
Were all patients included in the analysis?	Unclear		
Could the patient flow have introduced bias?		High risk	

Xu 2020

Study characteristics			
Patient Sampling	Study design: infected patients (symptomatic and asymptomatic)		
Patient characteristics and setting	Age group: children and adults Setting: inpatient		
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: unclear Level of training of readers: unclear		
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided; other		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	No		
Was a case-control design avoided?	No		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	No		
Could the conduct or interpretation of the index test have introduced bias?		High risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Unclear
DOMAIN 2: Index Test (Chest X-ray)			

Xu 2020 *(Continued)*

DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		High risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			High
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Xu 2020a

Study characteristics	
Patient Sampling	Study design: infected patients (symptomatic and asymptomatic)
Patient characteristics and setting	Age group: adults only Setting: inpatient
Index tests	Index test(s): chest CT; non contrast CT thorax Definition for positive diagnosis on CT: unclear Level of training of readers: radiologist
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided
Flow and timing	
Comparative	
Notes	
Methodological quality	

Xu 2020a *(Continued)*

Item	Authors' judgement	Risk of bias	Applicability concerns
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	No		
Was a case-control design avoided?	No		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	No		
Could the conduct or interpretation of the index test have introduced bias?		High risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		High risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			High
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Xu 2020b

Study characteristics			
Patient Sampling	Study design: infected patients (symptomatic and asymptomatic)		
Patient characteristics and setting	Age group: children and adults Setting: inpatient		
Index tests	Index test(s): chest CT; high resolution CT thorax Definition for positive diagnosis on CT: other Level of training of readers: radiologist		
Target condition and reference standard(s)	Reference standard: unclear		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	No		
Was a case-control design avoided?	No		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Yes		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			

Xu 2020b *(Continued)*

DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		High risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Low risk	

Xu 2020c

Study characteristics			
Patient Sampling	Study design: infected patients (symptomatic and asymptomatic)		
Patient characteristics and setting	Age group: children only Setting: inpatient		
Index tests	Index test(s): chest CT; chest radiographs/chest X-rays Definition for positive diagnosis on CT: unclear Level of training of readers: unclear		
Target condition and reference standard(s)	Reference standard: RT-PCR once		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**

Xu 2020c *(Continued)*

DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	No		
Was a case-control design avoided?	No		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Unclear
DOMAIN 2: Index Test (Chest X-ray)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Unclear
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		High risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Unclear
DOMAIN 4: Flow and Timing			

Xu 2020c *(Continued)*

Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Low risk	

Yang 2020

Study characteristics			
Patient Sampling	Study design: suspected patients		
Patient characteristics and setting	Age group: adults only Setting: unclear		
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: ground glass opacity, patch-like shadows, liver shadow, pleural effusion or pleural thickening Level of training of readers: unclear Prevalence: 0.2		
Target condition and reference standard(s)	Reference standard: unclear		
Flow and timing			
Comparative			
Notes			
Methodological quality			
Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	Yes		
Could the selection of patients have introduced bias?		Unclear risk	
Are there concerns that the included patients and setting do not match the review question?			Low concern

Yang 2020 *(Continued)*

DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	No		
Could the conduct or interpretation of the index test have introduced bias?		High risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			High
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Unclear		
Were all patients included in the analysis?	Unclear		
Could the patient flow have introduced bias?		Unclear risk	

Yang 2020a

Study characteristics	
Patient Sampling	Study design: symptomatic infected patients only
Patient characteristics and setting	Age group: adults only Setting: inpatient
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: unclear

Yang 2020a *(Continued)*

	Level of training of readers: unclear		
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided		
Flow and timing			
Comparative			
Notes			

Methodological quality

Item	Authors' judgement	Risk of bias	Applicability concerns
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	No		
Was a case-control design avoided?	Yes		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Unclear
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	

Yang 2020a *(Continued)*

Are there concerns that the target condition as defined by the reference standard does not match the question?			High
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Yes		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Low risk	

Yasukawa 2020

Study characteristics	
Patient Sampling	Study design: infected patients (symptomatic and asymptomatic)
Patient characteristics and setting	Age group: adults only Setting: inpatient
Index tests	Index test(s): ultrasound of the lungs (POCUS) Level of training of readers: radiologist
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided
Flow and timing	
Comparative	
Notes	

Methodological quality

Item	Authors' judgement	Risk of bias	Applicability concerns
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	No		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High

Yasukawa 2020 *(Continued)*

DOMAIN 2: Index Test (Chest CT)			
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	No		
Could the conduct or interpretation of the index test have introduced bias?		High risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			High
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Low risk	

Zeng 2020

Study characteristics	
Patient Sampling	Study design: asymptomatic infected patients only
Patient characteristics and setting	Age group: children and adults Setting: inpatient
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: unclear

Zeng 2020 *(Continued)*

	Level of training of readers: unclear		
Target condition and reference standard(s)	Reference standard: unclear		
Flow and timing			
Comparative			
Notes			

Methodological quality

Item	Authors' judgement	Risk of bias	Applicability concerns
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	No		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	No		
Could the conduct or interpretation of the index test have introduced bias?		High risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	No		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		High risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Unclear

Zeng 2020 *(Continued)*

DOMAIN 4: Flow and Timing		
Was there an appropriate interval between index test and reference standard?	Unclear	
Did all patients receive the same reference standard?	Yes	
Were all patients included in the analysis?	Unclear	
Could the patient flow have introduced bias?		Unclear risk

Zhang 2020

Study characteristics	
Patient Sampling	Study design: infected patients (symptomatic and asymptomatic)
Patient characteristics and setting	Age group: children and adults Setting: inpatient
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: any abnormality Level of training of readers: unclear
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided
Flow and timing	
Comparative	
Notes	

Methodological quality

Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High

Zhang 2020 *(Continued)*

DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Unclear
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Unclear
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Zhang 2020a

Study characteristics	
Patient Sampling	Study design: infected patients (symptomatic and asymptomatic)
Patient characteristics and setting	Age group: children and adults Setting: inpatient
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: any abnormality

Zhang 2020a *(Continued)*

	Level of training of readers: radiologist		
Target condition and reference standard(s)	Reference standard: RT-PCR twice		
Flow and timing			
Comparative			
Notes			

Methodological quality

Item	Authors' judgement	Risk of bias	Applicability concerns
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Yes		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Unclear
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Unclear

Zhang 2020a *(Continued)*

DOMAIN 4: Flow and Timing		
Was there an appropriate interval between index test and reference standard?	Unclear	
Did all patients receive the same reference standard?	Yes	
Were all patients included in the analysis?	Yes	
Could the patient flow have introduced bias?		Unclear risk

Zhao 2020

Study characteristics	
Patient Sampling	Study design: infected patients (symptomatic and asymptomatic)
Patient characteristics and setting	Age group: children and adults Setting: inpatient
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: pneumonia Level of training of readers: unclear
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided
Flow and timing	
Comparative	
Notes	

Methodological quality

Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High

Zhao 2020 *(Continued)*

DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Unclear		
If a threshold was used, was it pre-specified?	Unclear		
Could the conduct or interpretation of the index test have introduced bias?		Unclear risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Unclear
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Unclear
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

Zhao 2020a

Study characteristics	
Patient Sampling	Study design: infected patients (symptomatic and asymptomatic)
Patient characteristics and setting	Age group: children and adults Setting: inpatient
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: any abnormality

Zhao 2020a *(Continued)*

	Level of training of readers: radiologist		
Target condition and reference standard(s)	Reference standard: RT-PCR twice		
Flow and timing			
Comparative			
Notes			

Methodological quality

Item	Authors' judgement	Risk of bias	Applicability concerns
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Unclear		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High
DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Yes		
If a threshold was used, was it pre-specified?	Yes		
Could the conduct or interpretation of the index test have introduced bias?		Low risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			Low concern
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Unclear

Zhao 2020a *(Continued)*

DOMAIN 4: Flow and Timing		
Was there an appropriate interval between index test and reference standard?	Unclear	
Did all patients receive the same reference standard?	Yes	
Were all patients included in the analysis?	Yes	
Could the patient flow have introduced bias?		Unclear risk

Zhao 2020b

Study characteristics	
Patient Sampling	Study design: symptomatic infected patients only
Patient characteristics and setting	Age group: adults only Setting: inpatient
Index tests	Index test(s): chest CT Definition for positive diagnosis on CT: any abnormality Level of training of readers: radiologist
Target condition and reference standard(s)	Reference standard: RT-PCR, no other details provided
Flow and timing	
Comparative	
Notes	

Methodological quality

Item	**Authors' judgement**	**Risk of bias**	**Applicability concerns**
DOMAIN 1: Patient Selection			
Was a consecutive or random sample of patients enrolled?	Yes		
Was a case-control design avoided?	Yes		
Did the study avoid inappropriate exclusions?	No		
Could the selection of patients have introduced bias?		High risk	
Are there concerns that the included patients and setting do not match the review question?			High

Zhao 2020b *(Continued)*

DOMAIN 2: Index Test (Chest CT)			
Were the index test results interpreted without knowledge of the results of the reference standard?	Yes		
If a threshold was used, was it pre-specified?	Yes		
Could the conduct or interpretation of the index test have introduced bias?		Low risk	
Are there concerns that the index test, its conduct, or interpretation differ from the review question?			High
DOMAIN 2: Index Test (Chest X-ray)			
DOMAIN 2: Index Test (Ultrasound of the lungs)			
DOMAIN 3: Reference Standard			
Is the reference standards likely to correctly classify the target condition?	Unclear		
Were the reference standard results interpreted without knowledge of the results of the index tests?	Unclear		
Could the reference standard, its conduct, or its interpretation have introduced bias?		Unclear risk	
Are there concerns that the target condition as defined by the reference standard does not match the question?			Low concern
DOMAIN 4: Flow and Timing			
Was there an appropriate interval between index test and reference standard?	Unclear		
Did all patients receive the same reference standard?	Yes		
Were all patients included in the analysis?	Yes		
Could the patient flow have introduced bias?		Unclear risk	

CT: computed tomography; RT-PCR: reverse transcriptase polymerase chain reaction.

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Ai 2020c	Wrong setting
Bayraktarolu 2020	Wrong study design
Chang 2020	< 10 participants
Chen 2020a	Wrong outcomes

Study	Reason for exclusion
Chen 2020b	Wrong outcomes
Cheng 2020	Wrong outcomes
Colombi 2020	Wrong outcomes
Dai 2020	Wrong outcomes
Ding 2020	Wrong outcomes
Guan 2020c	<10 participants
Hao 2020	< 10 participants
Huang 2020d	< 10 participants
Lu 2020	Wrong patient population
Pan 2020a	Wrong outcomes
Poggiali 2020	Wrong outcomes
Sanchez Oro 2020	Wrong study design
Siegel 2020	Wrong study design
Song 2020	Wrong outcomes
Tavare 2020	Wrong study design
Wang 2020e	Wrong patient population
Wu 2020b	Wrong setting
Wu 2020c	Wrong setting
Wu 2020d	Wrong patient population
Wu 2020e	Wrong patient population
Xu 2020d	Wrong outcomes
Xu 2020f	< 10 participants
Yang 2020b	Wrong setting
Yuan 2020	Wrong indication

DATA

Presented below are all the data for all of the tests entered into the review.

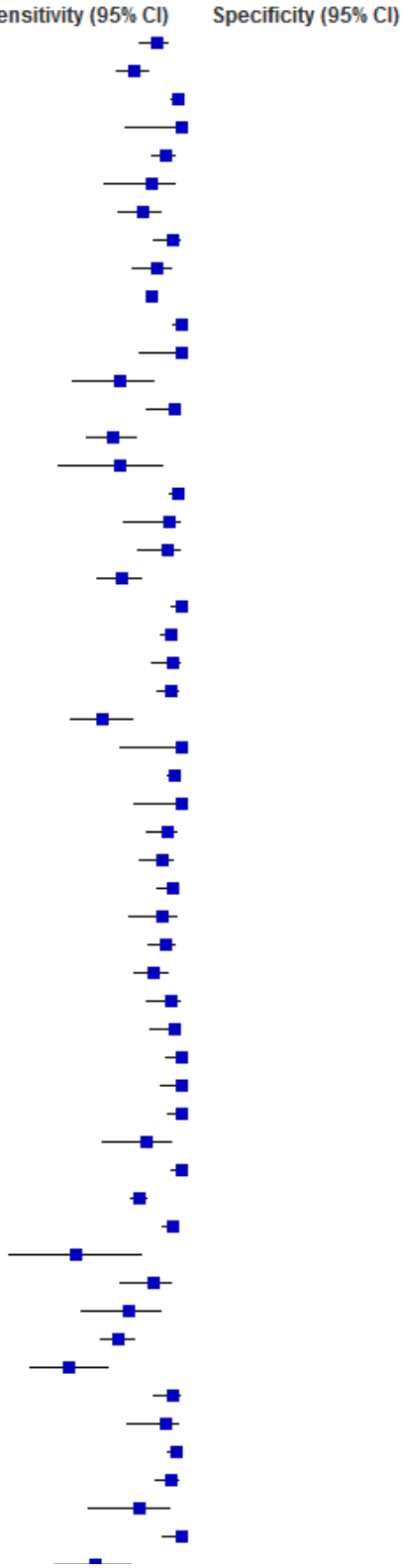
Table Tests. Data tables by test

Test	No. of studies	No. of participants
1 Chest CT in confirmed cases	65	5759
2 Chest X-ray in confirmed cases	9	682
3 Ultrasound of the lungs in confirmed cases	2	32
4 Chest CT in suspected cases	13	2346

Test 1. Chest CT in confirmed cases

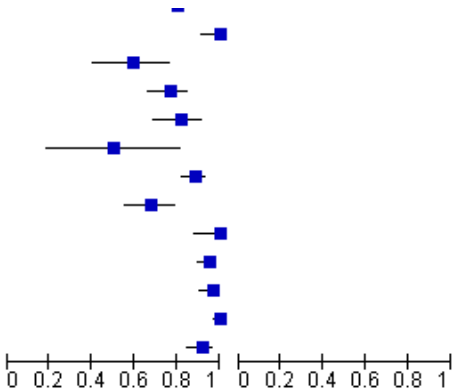
Chest CT in confirmed cases

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Ai 2020a	90	0	12	0	0.88 [0.80, 0.94]	Not estimable
Bernheim 2020	94	0	27	0	0.78 [0.69, 0.85]	Not estimable
Cao 2020	195	0	3	0	0.98 [0.96, 1.00]	Not estimable
Chate 2020	12	0	0	0	1.00 [0.74, 1.00]	Not estimable
Chen 2020	91	0	7	0	0.93 [0.86, 0.97]	Not estimable
Chung 2020	18	0	3	0	0.86 [0.64, 0.97]	Not estimable
Fang 2020	50	0	11	0	0.82 [0.70, 0.91]	Not estimable
Fu 2020	50	0	2	0	0.96 [0.87, 1.00]	Not estimable
Guan 2020	47	0	6	0	0.89 [0.77, 0.96]	Not estimable
Guan 2020a	840	0	135	0	0.86 [0.84, 0.88]	Not estimable
Han 2020	108	0	0	0	1.00 [0.97, 1.00]	Not estimable
Han 2020a	17	0	0	0	1.00 [0.80, 1.00]	Not estimable
Hu 2020	17	0	7	0	0.71 [0.49, 0.87]	Not estimable
Huang 2020	31	0	1	0	0.97 [0.84, 1.00]	Not estimable
Jie 2020	46	0	22	0	0.68 [0.55, 0.78]	Not estimable
Lei 2020	10	0	4	0	0.71 [0.42, 0.92]	Not estimable
Li 2020	130	0	2	0	0.98 [0.95, 1.00]	Not estimable
Li 2020a	17	0	1	0	0.94 [0.73, 1.00]	Not estimable
Li 2020b	30	0	2	0	0.94 [0.79, 0.99]	Not estimable
Li 2020c	56	0	22	0	0.72 [0.60, 0.81]	Not estimable
Li 2020d	83	0	0	0	1.00 [0.96, 1.00]	Not estimable
Li 2020e	125	0	6	0	0.95 [0.90, 0.98]	Not estimable
Li 2020f	49	0	2	0	0.96 [0.87, 1.00]	Not estimable
Liang 2020	84	0	4	0	0.95 [0.89, 0.99]	Not estimable
Liao 2020	29	0	17	0	0.63 [0.48, 0.77]	Not estimable
Lin 2020	11	0	0	0	1.00 [0.72, 1.00]	Not estimable
Ling 2020	246	0	9	0	0.96 [0.93, 0.98]	Not estimable
Liu 2020	15	0	0	0	1.00 [0.78, 1.00]	Not estimable
Liu 2020a	55	0	4	0	0.93 [0.84, 0.98]	Not estimable
Liu 2020b	58	0	6	0	0.91 [0.81, 0.96]	Not estimable
Liu 2020c	70	0	3	0	0.96 [0.88, 0.99]	Not estimable
Liu 2020d	30	0	3	0	0.91 [0.76, 0.98]	Not estimable
Liu 2020e	74	0	6	0	0.93 [0.84, 0.97]	Not estimable
Liu 2020f	68	0	10	0	0.87 [0.78, 0.94]	Not estimable
Lomoro 2020	40	0	2	0	0.95 [0.84, 0.99]	Not estimable
Long 2020	35	0	1	0	0.97 [0.85, 1.00]	Not estimable
Lyu 2020	51	0	0	0	1.00 [0.93, 1.00]	Not estimable
Ma 2020	37	0	0	0	1.00 [0.91, 1.00]	Not estimable
Meng 2020	58	0	0	0	1.00 [0.94, 1.00]	Not estimable
Pan 2020	20	0	4	0	0.83 [0.63, 0.95]	Not estimable
Shi 2020c	81	0	0	0	1.00 [0.96, 1.00]	Not estimable
Shu 2020	437	0	108	0	0.80 [0.77, 0.83]	Not estimable
Sun 2020	144	0	6	0	0.96 [0.91, 0.99]	Not estimable
Tan 2020b	5	0	5	0	0.50 [0.19, 0.81]	Not estimable
Tian 2020	32	0	5	0	0.86 [0.71, 0.95]	Not estimable
Tian 2020a	18	0	6	0	0.75 [0.53, 0.90]	Not estimable
Wan 2020	95	0	40	0	0.70 [0.62, 0.78]	Not estimable
Wang 2020	14	0	16	0	0.47 [0.28, 0.66]	Not estimable
Wang 2020a	50	0	2	0	0.96 [0.87, 1.00]	Not estimable
Wang 2020b	24	0	2	0	0.92 [0.75, 0.99]	Not estimable
Wang 2020c	161	0	4	0	0.98 [0.94, 0.99]	Not estimable
Wu 2020	76	0	4	0	0.95 [0.88, 0.99]	Not estimable
Xia 2020	16	0	4	0	0.80 [0.56, 0.94]	Not estimable
Xiong 2020	42	0	0	0	1.00 [0.92, 1.00]	Not estimable



Test 1. (Continued)

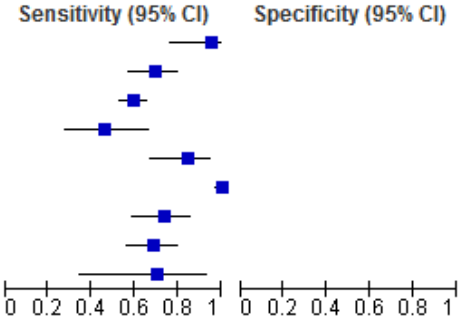
Xia 2020	16	0	4	0	0.80 [0.56, 0.94]	Not estimable
Xiong 2020	42	0	0	0	1.00 [0.92, 1.00]	Not estimable
Xu 2020	19	0	13	0	0.59 [0.41, 0.76]	Not estimable
Xu 2020a	69	0	21	0	0.77 [0.67, 0.85]	Not estimable
Xu 2020b	41	0	9	0	0.82 [0.69, 0.91]	Not estimable
Xu 2020c	5	0	5	0	0.50 [0.19, 0.81]	Not estimable
Yang 2020a	132	0	17	0	0.89 [0.82, 0.93]	Not estimable
Zeng 2020	46	0	22	0	0.68 [0.55, 0.78]	Not estimable
Zhang 2020	28	0	0	0	1.00 [0.88, 1.00]	Not estimable
Zhang 2020a	114	0	6	0	0.95 [0.89, 0.98]	Not estimable
Zhao 2020	71	0	2	0	0.97 [0.90, 1.00]	Not estimable
Zhao 2020a	110	0	0	0	1.00 [0.97, 1.00]	Not estimable
Zhao 2020b	93	0	8	0	0.92 [0.85, 0.97]	Not estimable



Test 2. Chest X-ray in confirmed cases

Chest X-ray in confirmed cases

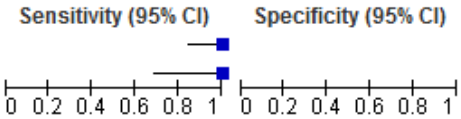
Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Arentz 2020	20	0	1	0	0.95 [0.76, 1.00]	Not estimable
Gaeta 2020	50	0	22	0	0.69 [0.57, 0.80]	Not estimable
Guan 2020a	162	0	112	0	0.59 [0.53, 0.65]	Not estimable
Kim 2020	13	0	15	0	0.46 [0.28, 0.66]	Not estimable
Lomoro 2020	27	0	5	0	0.84 [0.67, 0.95]	Not estimable
Wan 2020	135	0	0	0	1.00 [0.97, 1.00]	Not estimable
Wen 2020	34	0	12	0	0.74 [0.59, 0.86]	Not estimable
Wong 2020	44	0	20	0	0.69 [0.56, 0.80]	Not estimable
Xu 2020c	7	0	3	0	0.70 [0.35, 0.93]	Not estimable



Test 3. Ultrasound of the lungs in confirmed cases

Ultrasound of the lungs in confirmed cases

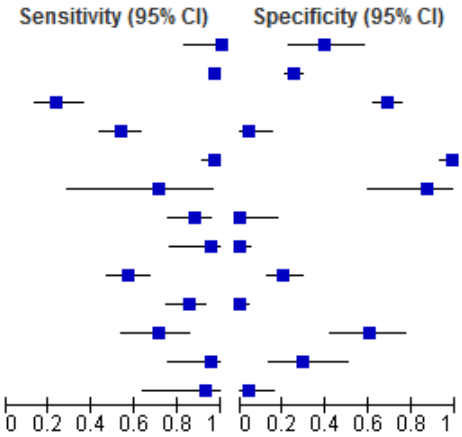
Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Lomoro 2020	22	0	0	0	1.00 [0.85, 1.00]	Not estimable
Yasukawa 2020	10	0	0	0	1.00 [0.69, 1.00]	Not estimable



Test 4. Chest CT in suspected cases

Chest CT in suspected cases

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Ai 2020	20	20	0	13	1.00 [0.83, 1.00]	0.39 [0.23, 0.58]
Ai 2020b	580	308	21	105	0.97 [0.95, 0.98]	0.25 [0.21, 0.30]
Bai 2020	14	64	46	141	0.23 [0.13, 0.36]	0.69 [0.62, 0.75]
Caruso 2020	62	42	54	2	0.53 [0.44, 0.63]	0.05 [0.01, 0.15]
Dong 2020a	91	1	3	72	0.97 [0.91, 0.99]	0.99 [0.93, 1.00]
Himoto 2020	5	2	2	13	0.71 [0.29, 0.96]	0.87 [0.60, 0.98]
Jiang 2020	44	19	6	0	0.88 [0.76, 0.95]	0.00 [0.00, 0.18]
Liang 2020a	20	67	1	0	0.95 [0.76, 1.00]	0.00 [0.00, 0.05]
Miao 2020	57	80	43	20	0.57 [0.47, 0.67]	0.20 [0.13, 0.29]
Miao 2020a	53	76	9	0	0.85 [0.74, 0.93]	0.00 [0.00, 0.05]
Peng 2020	25	13	10	20	0.71 [0.54, 0.85]	0.61 [0.42, 0.77]
Xiong 2020a	19	19	1	8	0.95 [0.75, 1.00]	0.30 [0.14, 0.50]
Yang 2020	12	40	1	2	0.92 [0.64, 1.00]	0.05 [0.01, 0.16]



APPENDICES

Appendix 1. Glossary

Terminology/acronyms

- **SARS-CoV-2:** severe acute respiratory syndrome coronavirus 2, the name given to the 2019 novel coronavirus.
- **SARS-CoV-2 infection:** people with severe acute respiratory syndrome coronavirus 2, but who may or may not have any clinical manifestations of infection
- **COVID-19:** coronavirus disease 2019, the clinical manifestations/ symptoms caused by infection with SARS-CoV-2, name given to the disease associated with the virus SARS-CoV-2
- **COVID-19** Pneumonia = COVID-19 that presents as infection-inflammation of the lungs

Appendix 2. QUADAS-2

QUADAS-2	
Index test(s):	Imaging studies of the chest (computed tomography (CT), chest X-ray and ultrasound) for diagnosis of COVID-19
Participants (setting, intended use of index test, presentation, prior testing):	People with suspected COVID-19 All settings, in particular secondary care, emergency care and ICUs In people presenting with suspected COVID-19; suspicion may be based on prior testing, such as general lab testing. Signs and symptoms often used for triage or referral
Reference standard and target condition:	A positive diagnosis for COVID-19 by: 1. A positive reverse transcriptase polymerase chain reaction (RT-PCR) test for SARS-CoV-2 infection, from any manufacturer in any country, from any source, including nasopharyngeal swabs or aspirates, oropharyngeal swabs, bronchoalveolar lavage fluid (BALF), sputum, saliva, serum, urine, rectal or faecal samples. 2. Positive on WHO criteria for COVID-19 which includes some testing RT-PCR negative. 3. Positive on China CDC criteria for COVID-19 which includes some testing RT-PCR negative.

(Continued)

	4. Positive serology in addition to consistent symptomatology. 5. Positive on study specific list of criteria for COVID-19 which includes some testing RT-PCR negative. 6. Other criteria (symptoms, imaging findings, other tests). A negative diagnosis for COVID-19 by: 1. COVID suspects with at least one negative RT-PCR. 2. Pre-pandemic controls (healthy or diseased). 3. Current healthy or with another disease (no RT-PCR test). This list is not exhaustive, as we anticipate that studies will use a variety of reference standards and we plan to include all of them, at least for the earlier versions of the review. Although RT-PCR is considered the best available test, it is suspected of missing a substantial proportion of cases, and thus may not be the ideal reference standard if used as a standalone test (Li 2020g; Loeffelholz 2020). Therefore, we are likely to use alternative reference standards, such as a combination of RT-PCR, and symptoms or imaging findings, or both. We will judge how likely each reference standard definition is to correctly classify individuals in the assessment of methodological quality. All reference standards are likely to be imperfect in some way; details of reference standard evaluation are provided in the 'Risk of bias' tool below. We will use a consensus process to agree the classification of the reference standard as to what we regard as good, moderate and poor. 'Good' reference standards need to have very little change of misclassification, 'moderate', a small but acceptable risk, 'poor', a larger and probably unacceptable risk.
Participant selection	
Was a consecutive or random sample of patients enrolled?	YES: if a study explicitly states that all participants within a certain time frame were included; that this was done consecutively; or that a random selection was done. NO: if it is clear that a different selection procedure was employed; e.g. selection based on clinician's preference, or based on institutions (ie, 'convenience' series) UNCLEAR: if the selection procedure is not clear or not reported at all.
Was a case-control design avoided?	YES: if a study explicitly states that all participants came from the same group of (suspected) patients. NO: if it is clear that a different selection procedure was employed for the participants depending on their COVID-19 status (e.g. proven infected patients in one group and proven non-infected patients in the other group). UNCLEAR: if the selection procedure is not clear or not reported at all.
Did the study avoid inappropriate in- or exclusions?	This needs to be addressed on a case-to-case basis. YES: If all eligible patients were more or less equally suspected of having COVID-19 and were included and if the numbers in the flow chart show not too many excluded participants (a maximum of 20% of eligible patients excluded without reasons). NO: If over 20% of eligible patients were excluded without providing a reason; if only proven patients were included, or only proven non-patients were included; if in a retrospective study participants without index test or reference standard result were excluded; if exclusion was based on severity assessment post-factum or comorbidities (cardiovascular disease, diabetes, immunosuppression). If the study oversampled patients with particular characteristics likely to affect estimates of accuracy. UNCLEAR: if the exclusion criteria are not reported.
Could the selection of patients have introduced bias?	HIGH: if one or more signalling questions were answered with NO, as any deviation from the selection process may lead to bias. LOW: if all signalling questions were answered with YES.

(Continued)

	UNCLEAR: all other instances
Is there concern that the included patients do not match the review question?	This needs to be addressed on a case-to-case basis, based on the objective the included study answers to. HIGH: if accuracy was assessed in a case-control design, or the study was able to only estimate sensitivity or specificity. LOW: any situation where imaging is generally available. UNCLEAR: if a description about the participants is lacking.
Index tests	
Were the index test results interpreted without knowledge of the results of the reference standard?	YES: if blinding was explicitly stated or index test was recorded before the results from the reference standard were available NO: if it was explicitly stated that the index test results were interpreted with knowledge of the results of the reference standard UNCLEAR: if blinding was unclearly reported.
If a threshold was used, was it pre-specified?	YES: for any of these index tests it is highly unlikely that any numerical threshold is used. Still we expect studies to report their criteria for test-positivity (e.g. the constellation of imaging findings used). If these criteria are reported in the methods section, we will score 'YES' for this question. NO: if the optimal criterion for test-positivity was based on the reported data (for example, different scores on a quantitative scoring system) we will score 'NO'. UNCLEAR: if the criteria for test positivity were not or unclearly reported.
Could the conduct or interpretation of the index test have introduced bias?	HIGH: if one or more signalling questions were answered with NO. LOW: if all signalling questions were answered with YES. UNCLEAR: all other instances
Is there concern that the index test, its conduct, or interpretation differ from the review question?	There is not a huge amount of variability from a technical perspective. Therefore, this question will probably be answered 'LOW' in all cases except when assessments are made using personnel not available in practice, or personnel not trained for the job, or using modalities that are uncommon in practice. We will consult expert clinicians on a case-to-case basis to judge this question.
Reference standard	
Is the reference standard likely to correctly classify the target condition?	YES: for COVID-19: RT-PCR, done by trained personnel, and repeated after a first negative RT-PCR, following guidelines for confirmed cases and done with an assay targeting minimum 2 targets in the genes N, E, S or RdRP (one target even acceptable in zone with known transmission). To clarify, a low risk of bias reference standard for true negative would require 2 (or more) negative RT-PCR results. NO: any other test UNCLEAR: if no reference standard was reported, or if it was just reported that RT-PCR was done.
Were the reference standard results interpreted without knowledge of the results of the index test?	YES: if it was explicitly stated that the reference standard results were interpreted without knowledge of the results of the index test, or if the result of the index test was obtained after the reference standard. NO: if it was explicitly stated that the reference standard results were interpreted with knowledge of the results of the index test or if the index test was used to make the final diagnosis (incorporation bias).

(Continued)

	UNCLEAR: if blinding was unclearly reported.
Could the conduct or interpretation of the reference standard have introduced bias?	HIGH: if one or more signalling questions were answered with NO. LOW: if all signalling questions were answered with YES. UNCLEAR: all other instances
Is there concern that the target condition as defined by the reference standard does not match the review question?	HIGH: there is a high concern regarding applicability of the reference standard if the reference standard actually measures a different target condition than the one we are interested in for the review. For example, if the diagnosis is only based on clinical picture, without excluding other possible causes of this clinical picture (e.g. other respiratory pathogens), then there is considerable concern that the reference standard is actually measuring something else than COVID-19. In addition, a positive RT-PCR only measures SARS-CoV-2 infection and not COVID-19 and therefore the reference standard for COVID-19 is a combination of positive RT PCR and symptoms and/or imaging findings. LOW: if above situations not present UNCLEAR: if intention for testing is not reported in the study
Flow and timing	
Was there an appropriate interval between index test(s) and reference standard?	YES: as the situation of a patient, including clinical presentation and disease progress, evolves rapidly and new/ongoing exposure can result in case status change. On the other hand, negative PCR results need to be repeated for several days. Therefore, an appropriate time interval will be within 7 days. NO: if there is more than 7 days between the index test and the reference standard or if patients are otherwise reported to be assessed with the index versus reference standard test at moments of different severity. UNCLEAR: if the time interval is not reported
Did all participants receive a reference standard?	YES: if all patients received a reference standard (clearly no partial verification) NO: if only (part of) the index test positives or index test negatives received the complete reference standard UNCLEAR: if it is not reported.
Did all participants receive the same reference standard?	YES: if all patients received the same reference standard (clearly no differential verification). Verification of negative PCR result with a second PCR measurement is considered to be one reference standard. NO: if (part of) the index test positives or index test negatives received a different reference standard UNCLEAR: If it is not reported.
Were all participants included in the analysis?	YES: if all included participants were included in the analyses as well NO: if after the inclusion/exclusion process, participants were removed from the analyses for different reasons: no reference standard done, no index test done, intermediate results of both index test or reference standard, indeterminate results of both index test or reference standard, samples unusable. UNCLEAR: If this is not clear from the reported numbers.
Could the patient flow have introduced bias?	HIGH: if one or more signalling questions were answered with NO, or if one question answered with NO was judged to have little impact on the methodological quality of the study (this should be justified in the scoring).

(Continued)

	LOW: if all signalling questions were answered with YES. UNCLEAR: all other instances

CT: computed tomography; **CXR:** chest X-ray; **ICU:** intensive care unit; **RT-PCR:** reverse transcriptase polymerase chain reaction; **SARS-CoV-2:** severe acute respiratory syndrome coronavirus 2; **US:** ultrasound

Appendix 3. Search strategies

1. Living search from the University of Bern

27 April 2020

From 27 April 2020, we retrieved the curated BioRxiv/MedRxiv dataset link

26 March 2020 to 27 April 2020

MEDLINE: (\"Wuhan coronavirus\" [Supplementary Concept] OR \"COVID-19\" OR \"2019 ncov\"[tiab] OR ((\"novel coronavirus\"[tiab] OR \"new coronavirus\"[tiab]) AND (wuhan[tiab] OR 2019[tiab])) OR 2019-nCoV[All Fields] OR (wuhan[tiab] AND coronavirus[tiab])))))

Embase: (nCoV or 2019-nCoV or ((new or novel or wuhan) adj3 coronavirus) or covid19 or covid-19 or SARS-CoV-2).mp

BioRxiv/MedRxiv: ncov or corona or wuhan or COVID or SARS-CoV-2

With the kind support of the Public Health & Primary Care Library PHC, and following guidance of the Medical Library Association

01 January 2020 to 27 April 2020

MEDLINE: ("Wuhan coronavirus" [Supplementary Concept] OR "COVID-19" OR "2019 ncov"[tiab] OR (("novel coronavirus"[tiab] OR "new coronavirus"[tiab]) AND (wuhan[tiab] OR 2019[tiab])) OR 2019-nCoV[All Fields] OR (wuhan[tiab] AND coronavirus[tiab])))))

Embase: ncov OR (wuhan AND corona) OR COVID

BioRxiv/MedRxiv: ncov or corona or wuhan or COVID

2. Cochrane COVID-19 Study Register searches

Source	Strategy
CT.gov	COVID-19*
WHO ICTRP	Health topic: 2019-nCov / COVID-19
PubMed	(("2019 nCoV"[tiab] OR 2019nCoV[tiab] OR "2019 novel coronavirus"[tiab] OR "COVID 19"[tiab] OR COVID19[tiab] OR "new coronavirus"[tiab] OR "novel coronavirus"[tiab] OR "novel corona virus"[tiab] OR "SARS CoV-2"[tiab] OR (Wuhan[tiab] AND (coronavirus[tiab] OR "corona virus"[tiab])) OR "COVID-19"[Supplementary Concept] OR "severe acute respiratory syndrome coronavirus 2"[Supplementary Concept]) NOT ("animals"[MeSH Terms] NOT "humans"[MeSH Terms])) NOT (editorial[pt] OR comment[pt] OR letter[pt] OR newspaper article[pt])

*Automatic term mapping links results for 2019-nCoV, 2019 novel coronavirus, SARS-CoV-2, severe acute respiratory syndrome coronavirus

3. CDC Library, COVID-19 Research Articles Downloadable Database

Embase records from the Stephen B. Thacker CDC Library, Covid-19 Research articles Downloadable database.

Records were obtained by the CDC library by searching embase through Ovid using the following search strategy.

Source	Strategy
Embase	(coronavir* OR corona virus* OR betacoronavir* OR covid19 OR covid 19 OR nCoV OR novel CoV OR CoV 2 OR CoV2 OR sarscov2 OR 2019nCoV OR wuhan virus*).mp. OR ((wuhan OR hubei OR huanan) AND (severe acute respiratory OR pneumonia*) AND outbreak*).mp. OR Coronavirus infection/ OR coronavirinae/ OR exp betacoronavirus/ Limits: 2020- OR (novel coronavir* OR novel corona virus* OR covid19 OR covid 19 OR nCoV OR novel CoV OR CoV 2 OR CoV2 OR sarscov2 OR 2019nCoV OR wuhan virus*).mp. OR ((wuhan OR hubei OR huanan) AND (severe acute respiratory OR pneumonia*) AND outbreak*).mp. OR ((wuhan OR hubei OR huanan) AND (coronavir* OR betacoronavir*)).mp. Limits: 2019-

HISTORY

Protocol first published: Issue 6, 2020
Review first published: Issue 9, 2020

CONTRIBUTIONS OF AUTHORS

All protocol authors reviewed, edited, contributed to, and approved the protocol.

The search was performed by RS, MMGL and LH.

DECLARATIONS OF INTEREST

Jean-Paul Salameh has no known conflicts of interest.

Mariska MG Leeflang has no known conflicts of interest.

Lotty Hooft has no known conflicts of interest.

Nayaar Islam has no known conflicts of interest.

Trevor McGrath has no known conflicts of interest.

Christian B van der Pol has no known conflicts of interest.

Robert A Frank has no known conflicts of interest.

Ross Prager has no known conflicts of interest.

Samanjit Singh Hare has no known conflicts of interest.

Carole Dennie has no known conflicts of interest.

René Spijker: the Dutch Cochrane Centre (DCC) has received grants for performing commissioned systematic reviews. In no situation, the commissioner had any influence on the results of the work.

Jonathan J Deeks has no known conflicts of interest.

Jacqueline Dinnes has no known conflicts of interest.

Kevin Jenniskens has no known conflicts of interest.

Daniel Korevaar has no known conflicts of interest.

Jérémie F Cohen has no known conflicts of interest.

Ann Van den Bruel has no known conflicts of interest.

Yemisi Takwoingi has no known conflicts of interest.

Janneke van de Wijgert has no known conflicts of interest.

Johanna AAG Damen has no known conflicts of interest.

Junfeng Wang received a consultancy fee from Biomind, an Artificial Intelligence (AI) company providing machine intelligence solutions in medical imaging. The consultancy service was about design of clinical studies, not related to this review. The company had no influence on the results of the work.

Matthew McInnes has no known conflicts of interest.

SOURCES OF SUPPORT

Internal sources

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External sources

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- National Institute for Health Research (NIHR), UK
- Government of Ontario Ministry of Health COVID-19 Rapid Response Research Grant program, Canada

DIFFERENCES BETWEEN PROTOCOL AND REVIEW

Secondary objectives

Our protocol included additional objectives to be evaluated as follows.

1. To evaluate whether these imaging tests are sufficiently accurate to rule out COVID-19 (main measure of interest will be the negative predictive value)
2. To evaluate the rate of positive imaging in patients with initial RT-PCR negative results who have a positive result on a follow-up RT-PCR test
3. To determine if there is an association between number of days after symptom onset, symptom severity and the findings on chest imaging for patients with COVID-19
4. To determine the rate of discrepancy or agreement between CT, chest X-ray and ultrasound findings
5. To evaluate for 'threshold' effects of imaging findings of COVID-19 and accuracy measures
6. To determine the rate of alternative diagnoses identified by chest imaging

We could not evaluate these objectives in the current version of our review because of lack of data reported in the identified studies.

Data extraction items

We had planned to extract information regarding participants' co-morbidities, especially chronic lung disease, such as asthma, chronic obstructive pulmonary disease (chronic bronchitis or emphysema).

This information was not extracted due to its absence in the included studies.

Sensitivity analyses

We had planned to undertake sensitivity analyses to determine the impact of including only:

1. published studies;
2. studies with low risk of bias for all QUADAS-2 domains.

Since most of the included studies at of high risk of bias due to study design (89% included confirmed cases only), it was not possible to undertake these analyses.

Investigations of heterogeneity

Our protocol included additional sources to be evaluated, such as: study design, disease prevalence, participant symptoms (severity), threshold for positivity, different reference standards, timing of symptom onset and other potential candidate variables.

Due to the lack of available data, these covariates were not investigated.